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A MESSAGE FROM THE ADMINISTRATOR

It is now 4 years since the Division of Fish and Wildlife was established to carry out BPA's responsibilities mandated by the Pacific Northwest Power Act. The Act gave BPA the authority to use its legal and financial resources to protect and enhance fish and wildlife resources harmed by hydroelectric development.

Fiscal Year (FY) 198.5 was a year of implementing plans and study findings and evaluating results. Progress has been encouraging; many of the projects started 1 and 2 years ago are now reaching their final stages. Construction activities accounted for approximately half the $25.5 million spent on fish and wildlife projects during the year.

It was also a record year for the Columbia salmon and steelhead runs. Rarely have so many upstream migrants been counted passing Bonneville Dam. Several factors were at play, including better harvest controls and the abatement of El Nino currents in the Pacific. But biologists believe the regionwide cooperative effort to rebuild anadromous fish runs - an effort funded to a large degree by BPA - is in part responsible for the mass returns to the spawning grounds.

BPA's habitat enhancement and passage improvement projects have opened up previously inaccessible streams to provide additional spawning and rearing habitat. The hope is that this will lead to even bigger runs in future years.

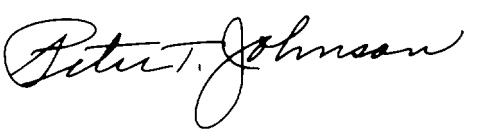
First, of course, juvenile salmon and steelhead have to reach the ocean in good health. Water Budget releases in 1985, carefully coordinated with hatchery releases, helped millions of smolts through reservoirs and over dams in a very dry year. Hatcheries released more young fish than at any time during the past 10 years.

Most of the 142 projects funded by BPA carry out the provisions of the Northwest Power Planning Council's Fish and Wildlife Program. In this annual report, the projects are summarized in seven categories. The majority of the year's projects began in 1983 and 1984; however, 22 new ones were initiated in 1985. Some will continue into the next decade, as scientists continue to collect data on returning adult migrants to evaluate the success of measures implemented in previous years.

In FY 1986, BPA plans to spend $33.3 million to continue the task of rebuilding and protecting our valuable fish and wildlife resources. Even fewer new projects will be started in 1986 than in 1985; the bulk of the year's funding is again committed to continuing construction activities.

I would like to stress that this BPA task is a cooperative venture. Project managers from the Fish and Wildlife Division work closely with and often depend on other Federal and State agencies and Indian tribes in implementing this historic program.

Salmon and steelhead populations are still at dangerously depleted levels. But this regionwide effort has given us the tools to rebuild fish and wildlife populations harmed by hydroelectric development in a way that has never before been seen in the world.



Peter T. Johnson

BACKGROUND/ THE NORTHWEST POWER PLANNING ACT

Salmon and steelhead populations once ran as high as 16 million fish by some estimates. What seemed a limitless resource 100 years ago has dwindled drastically as a direct result of human activities in and around the rivers and streams of the Columbia Basin.

The decline of the fish runs began around the turn of the century, when the first dams were built for flood control and irrigation. Overharvesting of salmon, waterfront development, streamside cattle grazing, clearcutting, and chemical fertilizers all contributed to the decline as the 20th century progressed. By the time the 30 dams of the Federal Columbia River Power System (FCRPS) were in place in the late 1970s the situation had become critical for some salmon and steelhead runs and too late for others, which disappeared completely.

Fish ladders were built at most of the Federal dams to provide passage for adult salmonids returning to upstream spawning grounds. But Grand Coulee Dam was too high for fish ladders, and access was blocked to more than 1,200 miles of prime spawning and rearing habitat. Vast reservoirs also flooded miles of what had been natural fish habitat for thousands of years.

Power generating authorities did not even foresee the many other problems that would be caused by the operation of hydroelectric facilities - fish losses due to turbine blades, slow moving currents in reservoirs, excessive predation, and gas-bubble disease.

BPA is now coordinating a long-term effort aimed at reversing the steep decline in anadromous fish populations. Other projects are also underway to protect wildlife from the effects of hydro operation.

The Pacific Northwest Power Act

The Pacific Northwest Electric Power Planning and Conservation Act of 1980 (Act) established the Northwest Power Planning Council (Council) and directed it to "promptly develop and adopt a program to protect, mitigate, and enhance fish and wildlife, including related spawning grounds and habitat, on the Columbia River and its tributaries."

The Council used recommendations from the region's Federal and State fish and wildlife agencies, Indian tribes, and other public and private groups, to create its Columbia River Basin Fish and Wildlife Program.

The landmark Act also defined a new role for BPA in charting the region's energy future. The agency was assigned the task of rebuilding and protecting fish and wildlife depleted by hydroelectric development and operation. Accordingly, BPA carries out a large part of the Council's Program.

PROJECT HIGHLIGHTS

To accomplish the goal of rebuilding and protecting the region's fish and wildlife resources, BPA in fiscal 1985 spent $25.5 million to fund 142 contracts, 120 of them existing projects and 22 new. This compares to $18 million spent in 1984 on 132 contracts.

More than 80 percent of the 1985 fish and wildlife budget was used to fund research studies and design and construction projects aimed at improving conditions for anadromous fish in the Columbia River Basin. Another 14 percent was devoted to studying and protecting game fish and sturgeon residing in upriver streams, lakes, and reservoirs. Wildlife projects received 3 percent of the funds.

About half the total funds BPA spent in 1985 - covering 38 projects - went to build fishways, rehabilitate or improve habitat, and construct propagation facilities.

In the Yakima Valley, a major effort is underway to rebuild the salmon fishery which has all but disappcarcd due to low water levels, poor water quality, and obstructed passage to potential spawning grounds. A total of I6 projects will work to provide safe passage for fish past irrigation dams and canals.

One Yakima project completed in March 1985 was the construction of a $3 million horizontal rotating mesh screen at Sunnyside dam to divert fish entering an irrigation channel back to the river. Studies indicate 100 percent of the young salmon and stcclhead are passing the screen safely. A new fish ladder was also in use and operating effectively on the dam's right bank, and another on the left bank will soon he finished. Screens and ladders at three other dams in the Yakima Valley will be completed in the spring of 1986 at a total cost of $8 million.

On Lake Pend Oreille. Idaho, construction crews finished the new $2.2 million Cabinet Gorge kokanee salmon hatchery in November, 1 year ahead of schedule. BPA and Washington Water Power Company arc sharing the construction costs. and Idaho Department of Fish and Game will operate and maintain the hatchery, which will produce 20 million kokanee a year starting in 1986.

Research studies accounted for 38 percent of 1985 expenditures. Biologists were testing a new computerized fish tagging technique called the passive integrated transponder, or PIT tag. The tags, coded to identify the host, are harmlessly implanted in young fish. Scanners mounted in fishways detect the tag and decode its message. If tests continue to be positive, this new technology will revolutionize fisheries research.

A study of the life history of the white sturgeon was also underway to fill a significant knowledge gap about this mysterious fluvial fish, which once migrated up and down the Columbia and its tributaries.

Several studies focused on the nutritional needs of young salmonids and on the threat predators pose to their survival. Other research projects tried to find ways to stop the spread of the deadly viruses that kill large numbers of hatchery fish.

1985 was the second full year of operation of the Water Budget, the centerpiece of the Council's plan to replenish depleted fish runs. In addition to costing some $58 million in lost revenues, this program took almost 11 percent of 1985 funds. Specially scheduled water releases from upriver dams helped flush some 65 million young salmon to the ocean-the largest downstream migration in 10 years - in one of the driest years in living memory (only 4 of the the past 60 years have been drier).

Adult salmon and steelhead also returned to the Columbia River in higher numbers. At Bonneville Dam, 3 million returning fish were counted – 20 percent over the 1984 total. Migratory fish made a historic comeback in the upriver streams of Idaho and northeastern Washington, and in some areas, such as the Yakima Basin, returns set 25-year records.

One of the more interesting projects during 1985 was conducted on the ridges northeast of the reservoir behind Libby Dam in Montana. There biologists of the Kootcnai National Forest and Montana Department of Fish, Wildlife, and Parks, working with BPA funds, are attempting to save a small band of unique mountain sheep from extinction.

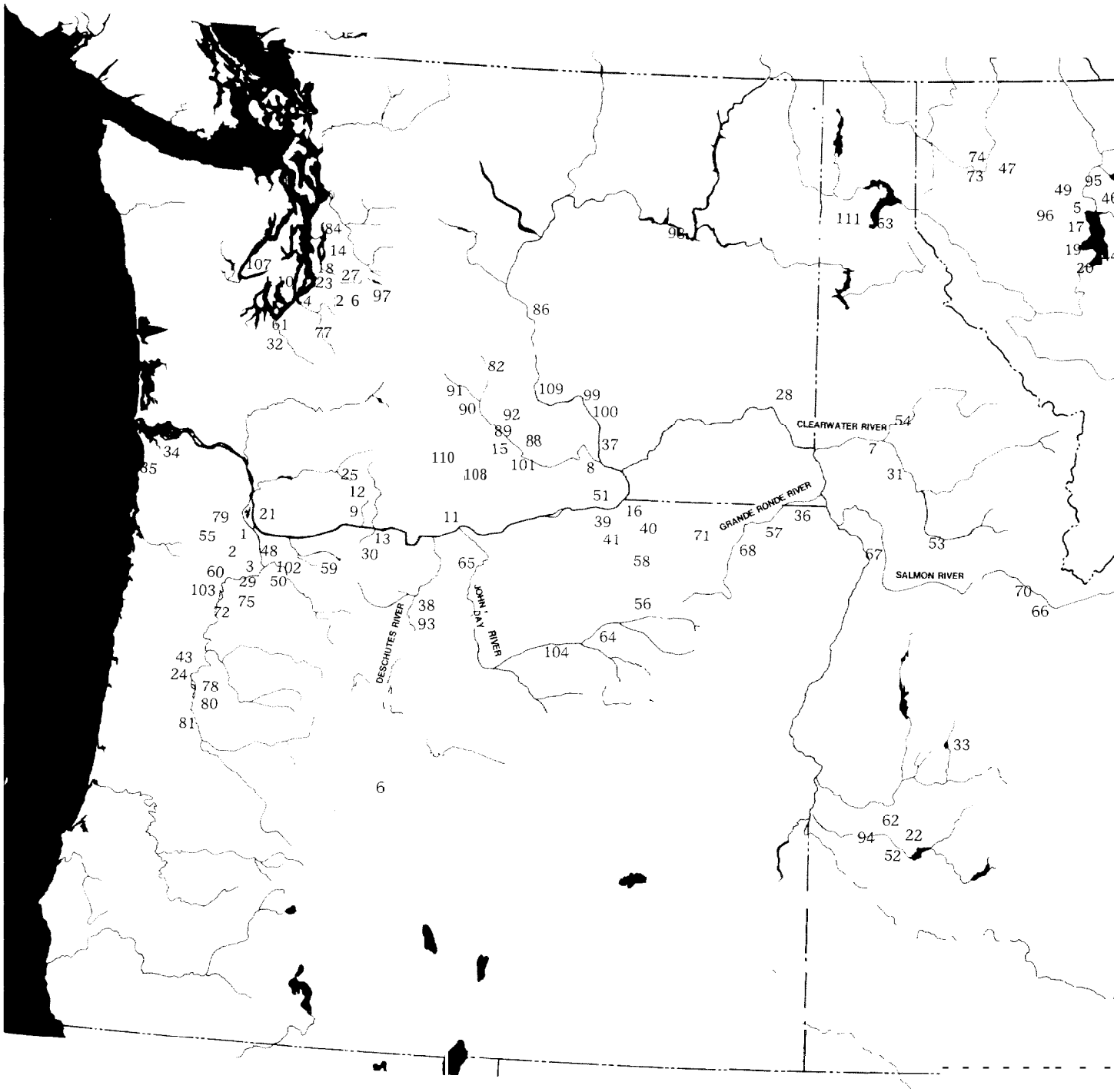
These sheep, called the Ural-Tweeds, once roamed the Rocky Mountains from Canada to western Montana. When Libby Dam flooded 12,000 acres of their last remaining habitat, there were 200 of the sheep left. The impact of the dam reduced their numbers to 25.

Two BPA projects are underway to itnprove the ridges abovc the lake by clearing away debris and reseeding grass on the slopes. The biologists watch the sheep closely to measure the results. Because the sheep now have a winter range and the ewes better spring forage. the tiny herd of mountain sheep is growing in number.

For further information or literature on specific projects, contact:

Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland. Oregon 97208

FISH & WILDLIFE PROJECTS



Downstream Migration

3. Smolt Monitoring Program
4. Flow and Spill Requirements for Juvenile Fall and Summer Chinook Salmon in John Day Reservoir
8. Use of a Fish Transportation Barge for Increasing Returns of Steelhead Trout Imprmted for Homing
9. Feeding Activity Rate Consumption, Daily Ration and Prey Selection of Major Predators in the John Day Reservoir Pool
11. Smolt Passage Behavior and Flow-Net Relationships in the Forebay of John Day Dam
13. Estimate Abundance and Growth Characteristics of Squawfish and Walleye in John Day Reservoir and Tailrace
14. Coded Wire Tag Sampling
21. Fish Tagging Trailer Operation & Maintenance
27. Biological Feasibility of a New Fish Tagging System
28. Smolt Condition and Timing of Arrival at Lower Granite Reservoir
37. Priest Rapids Summer Migrant Monitoring
48. Water Budget Management
50. Water Budget Management
60. Dissolved Nitrogen Gas Model
61. Smolt Monitoring at Federal Hydroelectric Facilities
62. Freeze Branding of Salmon and Steelhead for Water Budget Studies-Idaho
86. Juvenile Salmonid monitoring at Rock Island Dam Bypass Sampler
97. Juvenile Radio Tag Studies
105. Hydroacoustic Monitoring at Lower Monumental and Dalles Dams

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1. An Evaluation of the Contribution of Chinook Salmon Reared at Columbia River Hatcheries to the Pacific Salmon Fisheries
12. Bioenergetics of Juvenile Salmon During the Spring Outmigration
18. Control & Development of Hatchery Practices & Antiviral Drugs to IHN Virus in Sockeye Chinook Salmon and Steelhead Trout
23. Development of a Rapld Serodiagnostlc Test ior the Detection Surveillance, and Diagnosis oi Five Im-

portant Pathogens of Fishes in the Columbia River Basin
24. Epidemiology and Control of Infectous Diseases of Salmonids in the Columbia River Basin
25. Pen Rearing and Imprinting of Fall Chinook Salmon
31. Low Technology Fisheries Facilities
32. Low Cost Salmon and Steelhead Production Systems for the Columbia River Basin
34. Development for Rations for the Enhanced Survival of Salmon
35. Evaluation of Low-Cost Salmon Production Facilities.
40. Umatilla Release, Collection and Holding Facilities
43. Stock ID of Columbia River Chinook and Steelhead
52. Protection of Wild Steelhead in the Upper Snake River, Idaho
71. Umatilla River Summer Steelhead Hatchery-Feasibility Study
78. Development of a Subunit Vaccine Against Infec tious Hematopoietic Necrosis (IHN) Virus
79. Etiology of Earl Lifestage Diseases
80. Influence of Nutrition on the Immune Response in Hatchery Reared Salmonids (Cretomyxosis, Kidney Disease and Furunculosis)
81. Evaluate Vaccines for Bacterial Kidney Disease in Salmon
84. Survey of Artificial Production of Salmonids in the Columbia River Basin
103. Willamette Spring Chinook Study Plan
107. Electrophoresis Demonstration Project

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2. Study of Wild Spring Chinook in the John Day River
6. Establishment of Baseline Information for the Warm Springs Indian Reservation
7. A Biological and Physical Inventory of the Streams Within the Nez Perce Reservation
10. Snake River Fall Chinook Brood Program.
15. Natural Production Assessment and Rehabilitation of Spring Chinook in the Yakima River
22. Idaho Habitat Evaluation (Offsite Mitigation Record)
29. Stock Assessment of Anadromous Salmonids of Columbia River Basin
30. Hood River Passage
33. Rehabilitate and Protect Critical Anadromous Salmonids Spawning and Rearing Habitat in Bear Valley Creek
36. Peavine Creek Spawning Habitat Improvement
38. Trout Creek Riparian Habitat Restoration
39. Lower Umatilla River Channel Modifications to Allow Restoration of Upriver Bright Fall Chinook and Enhance Summer Steelhead Production in the Umatilla River Basin
41. Modification of Three Mile Dam to Improve Adult Salmon and Steelhead Passage in the Lower Reaches of Umatilla River
51. Lower Umatilla Channel Modifications Assessment
53. Red River/Crooked River Fish Passage Habitat Improvements
54. Clearwater River Habitat Enhancement (Lolo Crooked Fork, & El Dorado Creeks)
55. Coordination of Trout Creek Riparian Restoration.
56. John Day River Habitat Enhancement (Clear Granite, North Fork)
57. Grande Ronde Habitat Enhancement (Joseph. Peavine Elk & Chesnimnus Creeks)
58. Comprehensive Plan for the Restoration of Salmon and Steelhead in the Umatilla River Basin
59. Habitat Enhancement; Collawash Falls Fish & Lake Branch Creeks.
64. John Day River Habitat Enhancement (Main Stem, Middle Fork)
65. John Day River Habitat Enhancement (East Fork Beech Creek, Canyon, Big Boulder Granite Boulder Creeks)
66. Camas Creek Habitat Enhancement
67. Marsh Elk Creeks and Upper Salmon and Middle Fork Salmon River, Idaho Habitat Enhancement (Marsh Elk)
68. Grande Ronde River Habitat Enhancement
69. Lemhi River Habitat Rehabilitation-Idaho
70. Panther Creek Habitat Rehabilitation-Idaho
75. Protected Areas JMethodology
93. Trout Creek Rlparian Restoration
99. Tumwater Falls Dam Passage
100. Dryden Dam Passage
104. South Fork John Day River Passage Improvement Mainstem & Izee Falls
109. Tumwater/Dryden Fish Passage Environmental Assessment

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77. Evaluate Sources of Loss of Adult Salmon Between Bonneville and McNary Dams (Parts and Development of Radio Tags).
82. Predesign for the Construction of Renovations to Satus Creek, Upper Toppenish Creek, Marion Drain Taneum, Snipes/Allen Canal, Westside Ditch, Thorpe, Ellensburg Town Diversion, and Stevens Ditch-Yakima BAsin, WA,
87. Sunnyside Screen Construction-Yakima Basin, WA
88. Horn Rapids Screen Construction-Yakima Basin WA
89. Wapato Screen & Ladder Construction Yakima Basin WA.
90. Toppenish Creek/Satus Unit Screens & Ladder Construction; Yakima Basin, WA
91. Horn Rapids Screen Construction: Yakima Basin WA
92. Sunnyside Ladder and Old Reservation Canal Screen Construction; Yakima Basin WA
101. Evaluation of the Effectiveness of the Sunnyside Fish Screens and Richland Canal.
108. Temporary Fish Passage on Toppenish Creek, Yakima Basin, Washington
110. Construct a Security Fence for Sunnyside Right Bank Fish Ladder Yakima Basin, WA

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5. Effects of Operation of Kerr and Hungry Horse Dam on Reproductive Success of Kokanee in the Flathead System
17. Cumulative Impact Study of Microhydro Sites, Swan River
19. Lower Flathead River Fisheries Study
26. Columbia River White Sturgeon Enhancement
44. Evaluation of Water Releases at Painted Rocks Reservoir
46. Quantification of Hungry Horse Reservoir Levels Needed to Maintain or Enhance Reservoir Fisheries
47. Quantification of Libby Reservoir Levels Needed to Maintain or Enhance Reservoir Fisheries
63. Cabinet Gorge Kokanee Hatchery-Lake Pend Oreille, Idaho.
95. Determination of Instream Flows Needed for Successful Migration Spawning and Rearing of Rain bow and Cutthroat Trout in Selected Kootenai River Drainage Tributaries
96. Determination of Fishery Losses in the South Fork of the Flathead River and Tributaries Resulting from Flooding by Hungry Horse Reservoir and the Proposed Mitigation Alternatives
98. Preliminary Design of Colville Hatchery
102. Develop a Work Plan for Sturgeon Research.
111. Kokanee Stock Status in Lake Pend Oreille and Evaluation of Cabinet Gorge Hatchery

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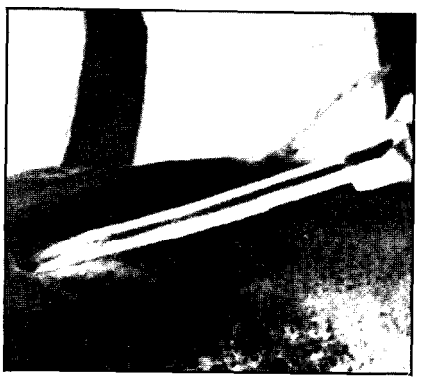
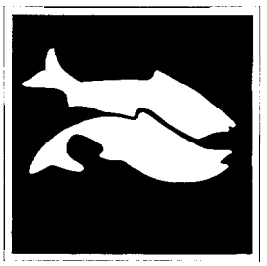
20. Impact of Water Levels on Canada Geese.
45. Evaluation of the Effects of Hungry Horse & Clark Fork Dams on Wildlife and Wildlife Habitat
49. Impacts of Water Level Fluctuations on Canada Geese: Flathead River Valley Montana
72. Wildlife and Wildlife Habitat loss Assessment for the Willamette River Projects
73. Ural-Tweed Bighorn Sheep-Wildlife Mitigation Project
74. Ural-Tweed Bighorn Sheep-Wildlife Mitigation Project
94. Wildlife and Wildlife Habitat Loss Assessments for the Anderson Ranch, Black Canyon, and Boise Divrsion Hydroelectric Facilities in Idaho.



WATER BUDGET & DOWNSTREAM MIGRATION

After young salmon and steelhead leave the spawning grounds far up the Columbia River, they face a whole series of manmade obstacles that can slow and often prematurely end their journey to the ocean. In their path are 13 run-of-the-river hydroelectric dams. Four Federally owned multi-purpose dams straddle the mainstem Columbia. Another four Federal dams hold the waters of the Snake River from its junction with the Columbia to Hells Canyon Dam. Five non-Federal dams stand on the upper Columbia. from the junction to Chief Joseph Dam. No anadromous fish pass above Chief Joseph or the Hells Canyon complex. In dry years, fewer than 10 percent of migrating smolts reach the ocean.

At the unscreened dams, ocean-bound fish are either swept over the top - when water is spilling - or drawn by the flow through the turbines. In the turbine housing, rapidly spinning blades and tremendous pressure changes can cause injury or death. Many survivors emerge in the tailrace of the dams dazed and disoriented and easily fall victim to waiting predators.

Slow-moving currents through vast reservoirs hamper the migrating smolts and subject them to considerable biological stress. Migration time is linked to survival in several ways. Prolonged delays expose smolts to predation and disease and can cause them to lose their time-critical ability to adapt to saltwater at the end of their journey.

To alleviate these problems, BPA in 1985 funded 20 projects to help downstream migration. In addition, 1985 was the second full year of operation of the Water Budget, an innovative procedure to augment river flows at migration time and the centerpiece of the regional strategy to make up for past fish losses at hydroelectric dams.

Water Budget and Downstream Migration: Project Descriptions

Water Budget Managers (83-491/536)

Smolt Monitoring Programs (80-1, 84-14, 84-15, 84-16, 84-17, 84-54)

Flows and Spill Requirements for Juvenile Fall and Summer Chinook Salmon in John Day Reservoir (81-1)

Use of a Fish Transportation Barge for Increasing Return s of Steelhead Trout Imprinted for Homing (82-2)

Feeding Activity, Rate of Consumption,Daily Ration, and Prey Selection of Major Predators in the John Day Reservoir (82-3)

Abundance and Growth Characteristics of Squawfish and Walleye in John Day Reservoir and Tailrace (82-12)

Smolt Passage Behavior and Flow-net Relationships in the Forebay of John Day Dam (82-8)

Smolt Condition and Timming of Arrival at Lower Granite Reservoir (83-323)

Total Dissolved Gas Measurement Data Transmission and System Modeling (84-13)

Juvenile Radio Tag Studies (85-35)

Hydroacoustic Studies at The Dalles and Lower Monumental Dams (85-83)

Ron Smith

Coho smolts on the first day of their journey down the Columbia River to the ocean

Water Budget Managers (83-491/536)

The cornerstone of the Council's Fish and Wildlife Program is the Water Budget, a predetermined volume of water that can be released each year from upriver storage dams to help flush smolts downstream during the critical migratory period between April 15 and June 15. This extra release of water is timed to parallel the spring runoff that would carry juveniles to the sea under natural conditions. Releases are scheduled to get smolts through slackwater reservoirs more quickly. reducing their exposure to predation, disease, and stress.

1985 was the second full year of formal water budget implementation, a year marked by below normal precipitation, record low streamflows, and historically high water temperatures in July. Water releases were coordinated with releases of some 65 million hatchery fish above Bonneville Dam.

Two Water Budget managers were selected in 1983 to coordinate the budgeted flows in cooperation with power system operators. They represent the State and Federal fish and wildlife agencies and the Columbia Basin Indian Tribes. The managers also collect and analyze data on flows, smolt travel time, survival rates, and returning adults to evaluate how well flow and spill manipulation and structural bypasses help fish survival.

The success of the Water Budget in increasing smolt survival depends on several other BPA-funded projects that monitor the progress and condition of the smolts.

Smolt Monitoring Programs (80-l, 84-14, 84-15, 84-16, 84-17, 84-54)

Water Budget managers need timely and accurate information on fish movements throughout the Columbia Basin so they can most effectively use the water reserved for helping salmon and steelhead downstream. Fish are monitored at dams operated by private utilities. public utility districts, and the Federal agencies.

The Smolt Monitoring Program supplies the data needed to evaluate the success of the Water Budget and to recommend changes for improving its efficiency.

Skimming water at theMcNary dam sluiceway.

The program (80-l) is coordinated by the Water Budget managers. Field monitoring activities are conducted at system dams by the National Marine Fisheries Service (NMFS) (84-14). BioSonics (84-15) and Chelan County Public Utility District (84-54). Fish used in the analyses are tagged – steelhead are freeze-branded in the Yakima River (84-16), and hatchery reared chinook salmon and steelhead are freeze branded in Idaho (84-17).

Flow and Spill Requirements for Juvenile Fall and Summer Chinook Salmon in John Day Reservoir (81-l)

Research continued on schedule in this project to determine how reservoir flows and spills affect the passage time, behavior, and survival of summer and fall chinook smolts as they pass through John Day Reservoir.

Since juvenile fish migrating in the spring clearly benefit from increased water velocities as flows increase, fishery agencies have in past years requested increased flows during the summer months to help carry summer migrants downstream. at a time when flows are naturally lower. But even during years of high flow, many young summer and fall chinook remain in the reservoir for extended periods. This suggests factors other than flow determine migration patterns of fall and summer chinook.

The data collected helps researcher relate instream flow and spill at the dam to the amount of time smolts spend in the reservoir. It will also help determine how their passage time influences their survival rate.

Researchers from the National Marine Fisheries Service initiated this project in 1981 and finished the first phase dealing with migrating juveniles in 1984. Work continued in1985 on the second phase, the monitoring of returning adult fish to determine the survival rate. This is scheduled for completion in 1987.

Use of a Fish Transportation Barge for Increasing Returns of Steelhead Trout Imprinted for Homing (82-2)

Physically transporting smolts downstream around the hazards of dams and reservoirs greatly increases their chances of survival. But young salmon and steelhead starting the outmigration by barge or truck may lose some or all of the homing instinct that guides them back to their stream or hatchery of origin as adults.

This 6-year study, begun in 1982, is one of several conducted by the NMFS to gather information about methods and techniques of increasing the return of transported fish to desired locations.

At the Dworshak National Fish Hatchery (NFH), researchers tagged

juvenile steelhead and imprinted them, providing biological clues to act as homing mechanisms. The fish were transported by truck to nearby Lewiston, Idaho, then transferred to a barge which carried them downstream for release below Bonneville Dam.

The project will determine whether these fish return in greater numbers to Dworshak Hatchery and the Idaho fishery than hatchery fish released directly into the stream. Investigators will learn how many fish in each release group have accepted a homing imprint, and this data will help them understand how a fish's physiological condition influences its ability to accept an imprint.

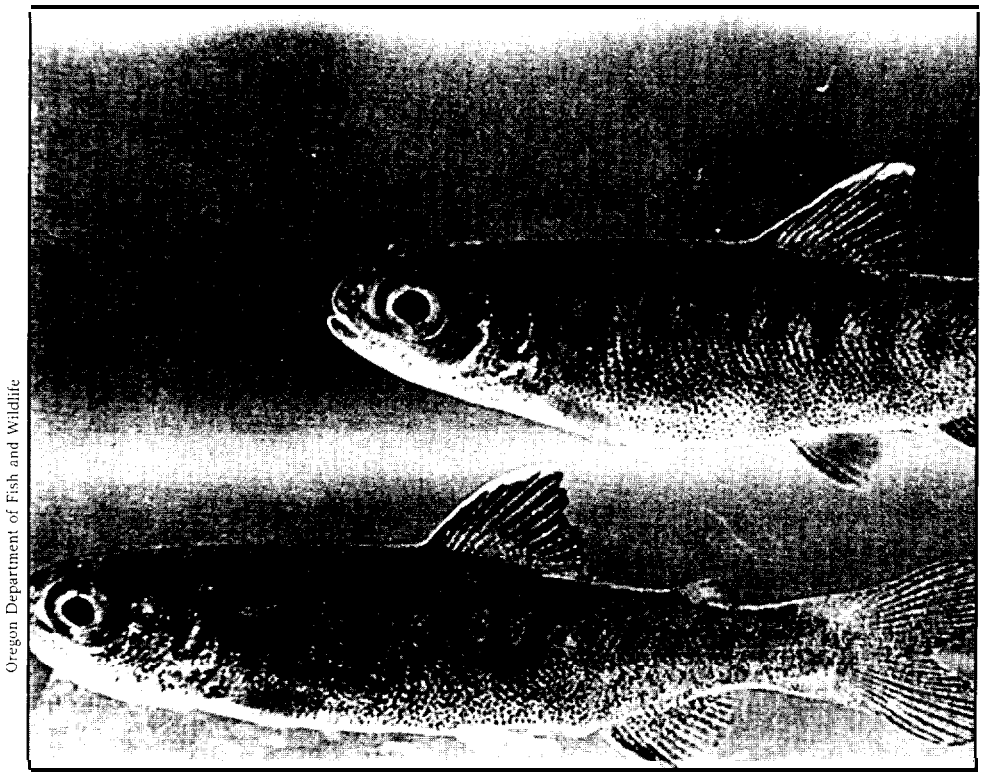
Work continued during 1985 on sampling returning adult steelhead at the collection facilities at Bonneville. McNary. and Lower Granite Dams, the Indian fishery on the Clearwater River, the sport fishery on the Snake and Clearwater Rivers. and at the Dworshak NFH homing site. Analysis of returns will continue through 1987, and the final results should provide resource managers with useful information for increasing steelhead runs.

Feeding Activity, Rate of Consumption, Daily Ration, and Prey Selection of Major Predators in the John Day Reservoir (82-3); Abundance and Growth Characteristics of Squawfish, Walleye, and Smallmouth Bass in John Day Reservoir and Tailrace (82-12)

The Columbia River mainstem reservoirs created by hydroelectric projects have greatly increased the number of predator fish, a factor which has had an impact on the survival rates of juvenile salmon and steelhead. These two related studies are investigating to what extent young salmonids are preyed upon by resident populations of native and introduced fish in the John Day reservoir and tailrace.

The U.S. Fish and Wildlife Service is studying three major predators in Project 82-3 — squawfish, walleye. and smallmouth bass – and evaluating how each contributes to the overall problem.

Oregon Department of Fish and Wildlife. in Project 82-12, develops population estimates of the three major predators. and this data helps USFWS to determine the location, timing and species of resident fish that prey on salmonids.



Oregon Department of Fish and Wildlife

Young salmon depend on high flows to carry them through the reservoirs and out to the ocean.

During 1985, further laboratory experiments and new computer programs provided data which will help USFWS biologists estimate the consumption rates of each predator. With this information, they will be able to estimate the number of young salmonids lost. ODFW researchers continued throughout the year to track the seasonal movements of predators and estimate their numbers.

By 1988, data from the two studies will have been combined to develop mechanical and/or biological techniques to control predation, which if successful could greatly increase the survival of salmon and steelhead migrating downstream.

Oregon Department of Fish and Wildlife

The computer chip in this steelheads jaw tag gives it a unique identification number.

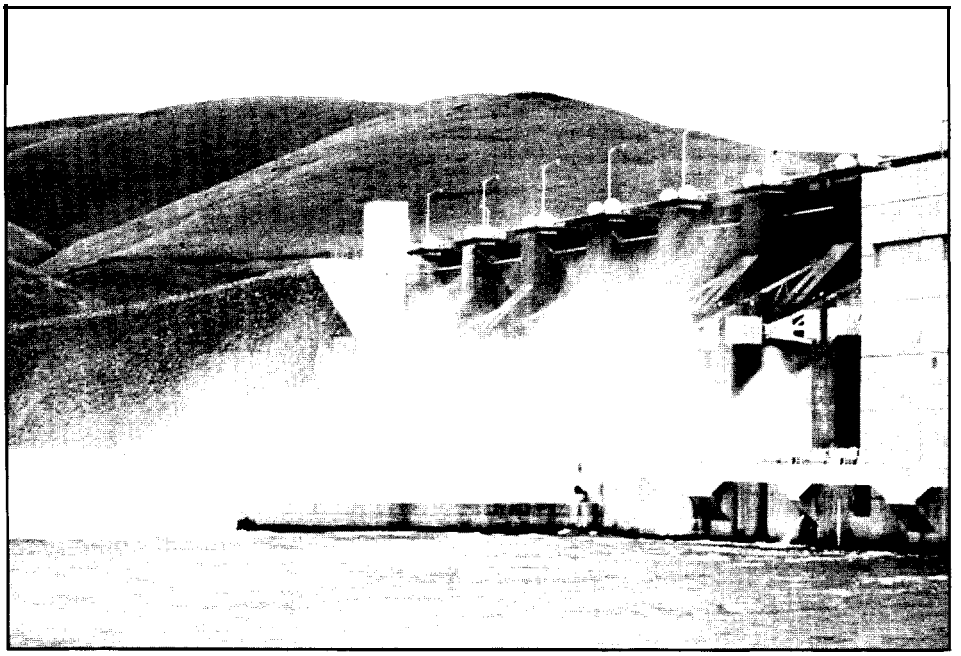
Smolt Passage Behavior and Flow-net Relationships in the Forebay of John Day Dam (82-8)

To enhance the survival of migrating juveniles, at hydroelectric facilities the National Marine Fisheries Service is studying the flow-net (water velocity vectors) at John Day Dam under various flow and spill conditions. Researchers relate the flow-net patterns to the movements of migrating salmon and steelhead smolts.

If they can find a correlation between the flow-net and efficient smolt passage, they will be able to define the operating conditions that will ensure better smolt survival. The project can then be extended to other Columbia River dams.

Researchers investigated the passage behavior of smolts through flow-net monitoring, purse seine sampling. and smolt radiotracking. They then developed a computer model to assist in maximizing smolt passage conditions while minimizing the possible adverse impacts on power production.

Purse seining operations in 1983 and 1984 indicated that the discharge from



Bonneville Power Administration

Lower Granite Dam one of the checkpoints for Water Budget flows.

the John Day River and the turbid plume it forms in the forebay may have a pronounced effect on the distribution of smolts as they approach the dam. These data suggest that the plume may be shunting salmon towards the Washington (spill) side of the river. where they may be more likely to pass over the spillway.

The project team also successfully executed a new research application of radio-tag methodology. An average of 79 percent of fish in various groups of spring chinook salmon smolts fitted with radio tags released 6 km upstream from John Day Dam successfully migrated to and were detected at the dam. Researchers were able to positively identify the specific passage route (spillway. powerhouse, fish ladder. or navigation lock) used by each uniquely coded individual fish.

The project was completed in late 1985.

Coded Wire Tag Recovery Program (82-13)

Many of BPA's research activities depend on data from coded wire tags implanted in fish to evaluate the various species' survival rates. timing of migrations. and contribution to fisheries.

But first the tags – microscopic strands of wire coded to identify the fish – must be recovered from ocean and freshwater sport and commercial catches. Other Federal and State fish and wildlife agencies and regional Indian tribes. both in the U.S. and Canada, also tag fish and analyze recoveries.

The Pacific Marine Fisheries Commission coordinates the overall recovery effort. ensuring that all fisheries are sampled and that duplicate sampling is avoided. Through this project BPA contributes an annual "fair share" to PMFC's recovery effort.

New Fish Tag System (83-319)

Harnessing the latest computer technology to collect data on migrating fish, National Marine Fisheries Service researchers are conducting experiments with a new tagging technique using small computer chips called passive integrated transponders. or PIT tags. These miniature chips are being developed for harmless implantation in the body cavity of smolts.

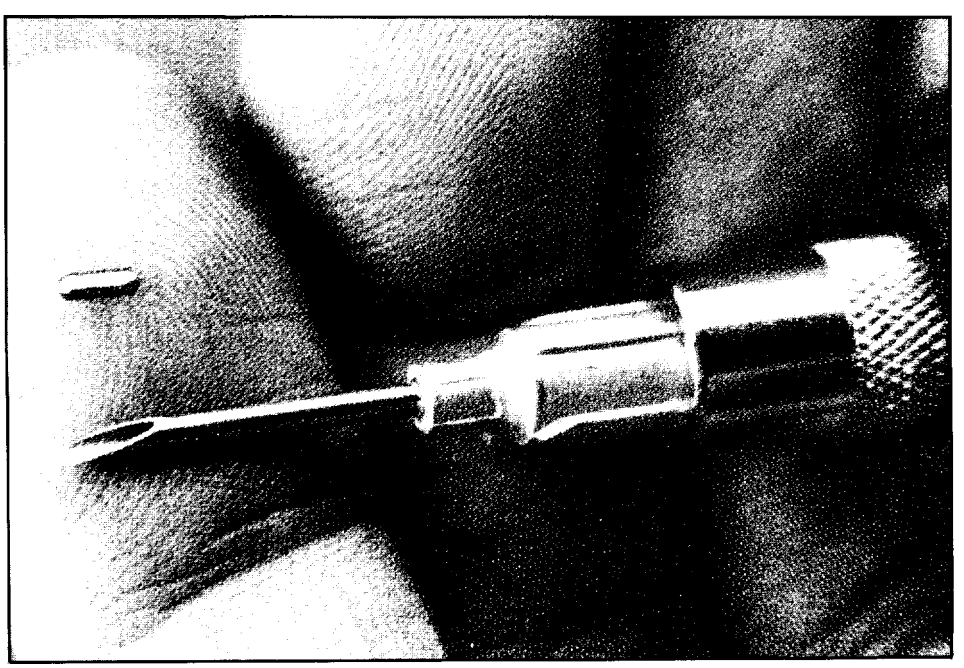
Each PIT tag, about the size of a grain of rice stores 1 of 34 billion codes providing a complete life history of the host fish. It incorporates a tiny antenna, enabling scientists to "read" its coded information with a scanner.

If this project is successful, scanners mounted in fishways and turbine bypass systems will be able to monitor every tagged fish passing through the system. Unlike the conventional tagging system. the PIT tag will not delay or harm the fish. A functional tag should be available for use by 1986.

With data from tagging studies. researchers will be able to identify sources of injury or delay for migrating fish at different sites. Correcting these problems will also allow for more efficient use of water for hydroelectric and fishery needs.

Smolt Condition and Timing of Arrival at Lower Granite Reservoir (83-323)

Chinook and steelhead smolts reared in Idaho hatcheries and the natural environment pass through numerous dams to reach the ocean each spring.



A computer chip and antenna are contained in this new salmon tag.

They are subject to many hazards and can be delayed by low river flows. especially in the reservoirs. Many smolts arriving at the Lower Granite bypass facility show substantial scale loss and other signs of deteriorating health.

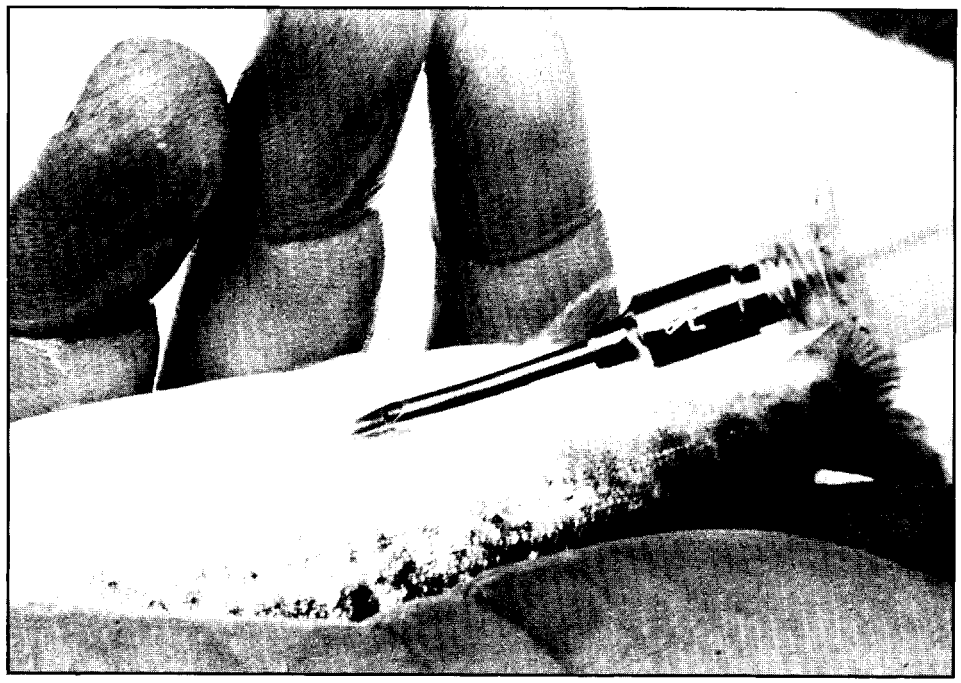
In this study. scheduled to run through 1990. biologists from the Idaho Department of Fish and Game catch smolts in special traps installed in the Lower Snake and Clearwater Rivers and evaluate their condition. The traps were designed and built. using BPA funds. by the National Marine Fishcrics Service. Project personnel also time the arrival of large groups of migrants - important information for Water Budget managers. who can then schedule water releases to move the smolts rapidly downstream.

The biologists also study downstream migration timing under different river discharge conditions and monitor the smolts physical condition during the trip. Biologists are trying to determine how much descaling occurs before the fish reach the Lower Granite area.

Total Dissolved Gas Measurement Data Transmission and System Modeling (84-13)

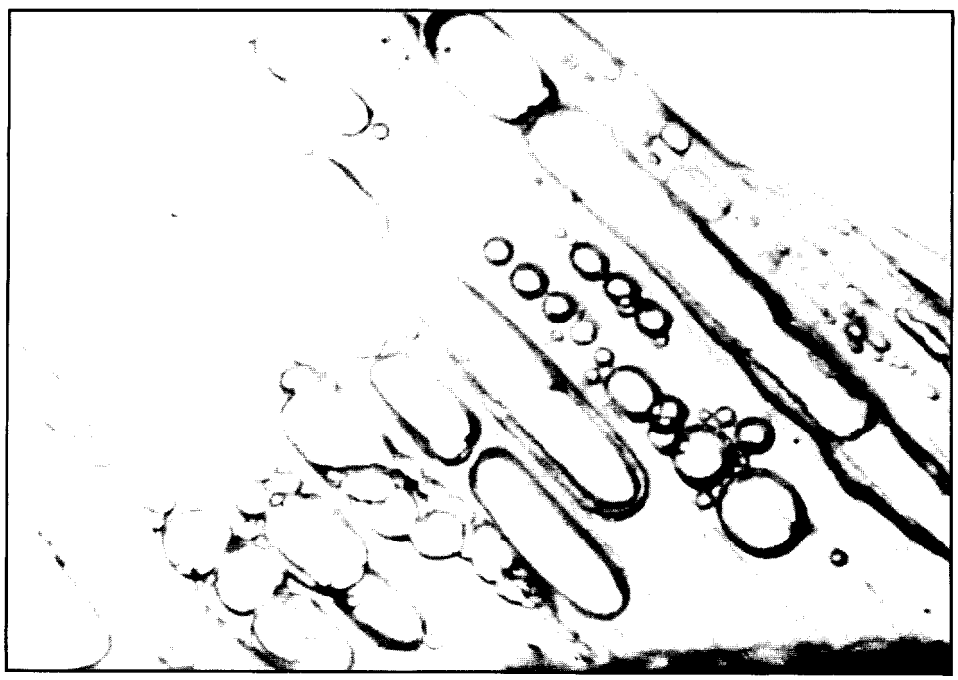
Gas bubble disease is a potentially fatal condition that can afflict migrating fish exposed to water supersaturated with dissolved air, as is frequently found in the turbulent waters at the bottom of dam spillways. The Army Corps of Engineers has been monitoring total dissolved gas (TDG) along the Columbia and Snake rivers since 1970. This activity helps minimirc fish mortality during high-flow years with extensive spills and during water releases requested by Water Budget managers.

Collecting data to support efficient water management can be done by field measurement. mathematical modeling, or a combination of both. There are more than 10 TDG sampling stations currently operating throughout the Columbia Basin. Running a model can be much less expensive. but first an extensive monitoring network is needed to calibrate the model. An accurate model would eventually replace most of the monitoring stations. reducing operational costs considerably. and would provide almost unlimited flexibility in predicting TDG levels under a variety of spill patterns and schedules.



National Marine Fisheries Service

Biologist inserts a computer chip tag in a young salmon's belly



Bonneville Power Administration

A steelhead dorsal fin showing the effects of gas bubble disease

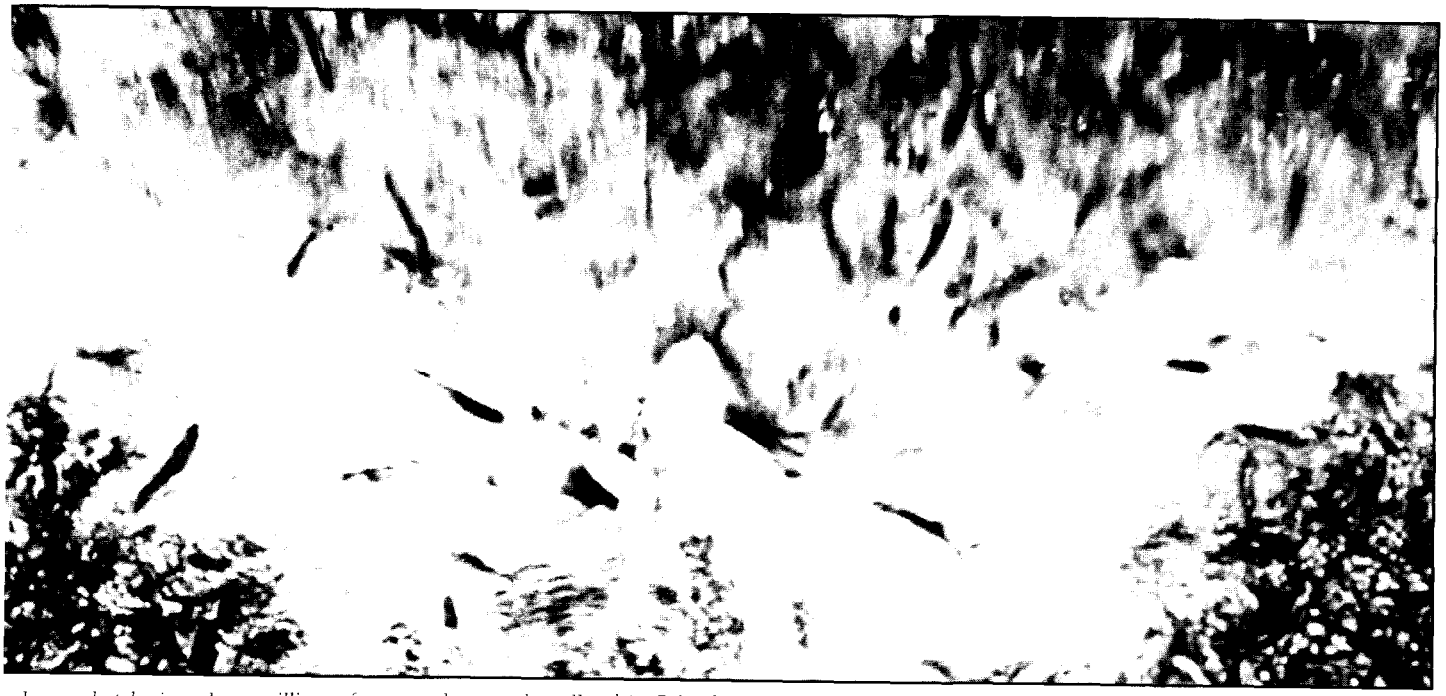
This 2-year study, funded jointly by the Corps and BPA. is helping to set up a system-wide monitoring network, with coordinated procedures for collecting and transmitting data. and provide accurate simulation capability for predicting TDG levels and allocating optimum spills

Juvenile Radio Tag Studies (85-35)

In this research project, the National Marine Fisheries Service is measuring spill effectiveness at Lower Granite Dam and testing the use of radio tags in juvenile salmonids as a tool to measure collection efficiency, guidance system efficiency. spillway survival, powerhouse survival. and collection system survival,

A related 1984 study funded by BPA evaluated radio-tagging techniques at John Day Dam, where up to 90 percent of radio-tagged spring chinook salmon released above the dam were monitored passing the dam within 48 hours.

At Lower Granite, researchers have set up a system of strategically located detector antennas to detect and record the tagged juveniles as they pass



ach year, hatcheries release millions of young salmon and steelhead in Columbia Basin waters.

trough the spillway. powerhouse. bypass system, or tailrace below the am. The study continues through 1987.

Hydroacoustic Studies at The Dalles nd Lower Monumental Dams (85-83)

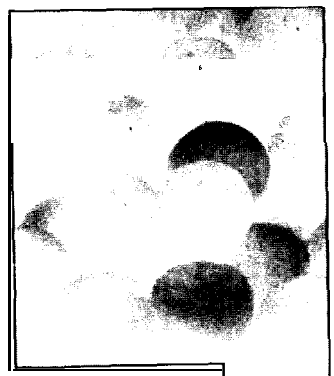
.s part of the continuous effort to ollect accurate data on fish ıovements, BPA contracted with iosonics to conduct hydroacoustic monitoring of downstream migrating almon and steelhead at The Dalles Dam on the Columbia River and at Lower Monumental Dam on the Snake River during 1985.

High frequency hydroacoustic systems. operating 24 hours a day, were used to monitor daily and seasonal patterns of fish passage into turbine units. through open spill gates. and into the sluiccway (at The Dalles Dam).

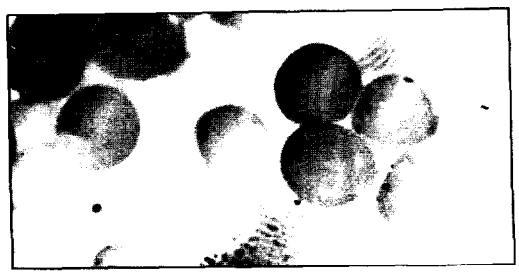
Researchers also sought to analvze the vertical and horizontal distribution of migrating fish as they entered the powerhouse and the spillbays.

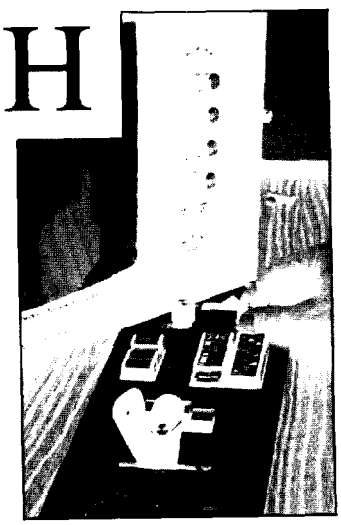
Scientists are interested in how many of which species of downstream migrants traverse the dams, at what time of day. at what point in the season. and what percentage go through the turbines and over the spill gates.

ieelhead smolts - ready to begin their life in saltwater



ARTIFICIAL PROPAGATION AND FISH HEALTH





Artificial propagation now stands as the main source of juvenile salmon and steelhead production. In the wild, only 5 to 15 percent of all salmonid eggs reach the smolt stage, but in hatcheries that number can increase to 70 or 80 percent.

The extra hatchery production can be used for rebuilding depleted runs and populating newly opened streams. Federal and State agencies and private utilities have built fish hatcheries throughout the Pacific Northwest to compensate for the damage done by dams. Returning salmon are guided into holding ponds, where eggs arc collected, incubated, and reared under conditions determined by man.

Over the years, hatcheries have been successful in producing large numbers of fish, but not without serious problems. Hatchery production has altered the natural pattern of genetic selection and produced less genetic diversity. Fish are paired and spawned regardless of their health, a practice that transmits disease from parent to offspring.

Thousands of young fish, all of the same age and genetic strain, are crowded into rearing ponds. Crowding causes stress and increases susceptibility to disease. Disease also spreads more rapidly in this setting than in natural rearing areas.

BPA has been funding studies since 1979 to improve the effectiveness of hatchery contributions to the Columbia Basin fish runs. Biologists are searching for ways to provide better nutrition, prevent disease and stress, and improve smolt quality. They are examining the timing of smolt releases and are working to improve the quality of smolts so more hatchery fish will survive the stresses of migration.

Biologists are also concerned about the complications that can arise from the integration of hatchery releases and wild runs, both during rearing and harvest. If enough wild fish existed, the effect of hatchery production might not pose a serious problem. But in many parts of the Columbia Basin, 80 percent of the salmon are now raised in hatcheries. And the percentage continues to rise.

Artificial Propagation and Fish Health: Project Descriptions

Evaluation of the Contribution of Fall Chinook Salmon Reared at Columbia River Hatcheries to the Pacific Salmon Fisheries (79-2)

Bioenergetics of Juvenile Salmon During the Spring Outmigration (82-11)

Development of Hatchery Practices and Antiviral Drugs to Control IHN Virus in Sockeye and Chinook Salmon and Steelhead Trout (82-21)

Development of Rapid Seriodiagnostic Tests for the Detection. Surveillance, and Diagnosis of Five Important Pathogens of Fishes in the Columbia River Basin (83-304)

Epidemiology and Control of Infectious Diseases of Salmonids in the Columbia River Basin (83-312)

Pen Rearing and Imprinting of Fall Chinook Salmon (83-313)

Development of Diets for Enhanced Survival of Salmon (83-363)

Evaluation of Low Cost Salmon Production Facilities (83-364)

Minthorn Springs Creek Summer Steelhead Juvenile Release and Adult Collection Facility (83-435)

Operation & Maintenance of Bonifer Springs Acclimation Facilities (82-18)

Stock Identification of Columbia River Chinook Salmon and Steelhead Trout (83-451)

Protection of Wild Adult Steelhead in Idaho by Adipose Fin Removal (84-2)

Umatilla River Summer Steelhead Hatchery (84-33)

Development of a Subunit Vaccine Against IHN (84-43)

Etiology of Early Lifestage Diseases (84-44)

Influence of Vitamin Nutrition on the Immunity Response of Hatchery-reared Salmonids (84-45)

Evaluate Vaccines for Bacterial Kidney Disease in Salmon (84-46)

Willamette Spring Chinook Study Plan (85-68)

Electrophoresis Genetic Stock Identification Project (85-84)

Evaluation of the Contribution of Fall Chinook Salmon Reared at Columbia River Hatcheries to the Pacific Salmon Fisheries (79-2)

An important part of the regional program to make up for fish lost through hydroelectric development is the construction and operation of hatcheries. Some chinook hatcheries consistently make a significant contribution to ocean and in-river fisheries, with enough adult fish returning each year to maintain stocks, Other facilities. however. release equal numbers of young fish but, for unknown reasons, contribute far less to fisheries and see fewer returning adults.

In this 8-year project. NMFS biologists first implanted almost I3 million coded wire tags in three successive brood years of hatchery-raised fall chinook. Then they sampled Pacific coast marine fisheries from California to Alaska and Columbia River fisheries. hatcheries. and adjacent streams for tagged fish from the project.

When all the information has been collected, some time in 1986, researchers will be able to compare how each hatchery release has contributed to salmon fisheries. They will study the importance of such variables as disease history, smolt size at release, diet, and time of release.

With this information, hatchery managers will be able to alter production techniques to improve results and thereby become more efficient in mitigating fish losses from hydroelectric development

Bioenergetics of Juvenile Salmon During the Spring Outmigration (82-11)

Dams and slower stream flows in reservoirs reduce the migration speed of young salmon. In this study, the U.S. Fish and Wildlife Service is investigating how much extra energy smolts require and whether the physical strain of a longer trip reduces their chances of survival.

During their extended outmigration period, smolts, particularly those reared in hatcheries, have trouble finding food. The amount of energy, or fat, they have stored can be critically important to their ability to survive until they reach the ocean.

Wes Tait

Biologists examine salmon from egg to adult to find ways to improve fish health.

Researchers have evaluated how much energy young salmon need at different water temperatures and at different flow levels. They have also explored how important certain types of food are in the smolts' total energy budget. The project was completed at the end of FY 1985.

Development of Hatchery Practices and Antiviral Drugs to Control IHN Virus in Sockeye and Chinook Salmon and Steelhead Trout (82-21); Development of Rapid Seriodiagnostic Tests for the Detection, Surveillance, and Diagnosis of Five Important Pathogens of Fishes in the Columbia River Basin (83-304)

Infectious Hematopoietic Necrosis (IHN) viral infections have caused the destruction of many millions of hatchery fish in the Columbia River system in recent years. The virus is believed to be transmitted either through the reproductive process or directly through water. All salmon species and cutthroat, rainbow, and steclhead trout are susceptible to the disease, which can virtually wipe out a hatchery's annual production. Mortality ranges from 60 to 98 percent.

The U.S. Fish and Wildlife Service is testing brood stock culling in project 81-21 as a way to control the IHN virus. By this method, fish carrying high levels of the virus are culled from the stock of parent fish used for hatchery propagation. After 3 years of culling, the incidence of IHN has been substantially reduced at one test hatchery, but the cause and effect relationship is still uncertain.

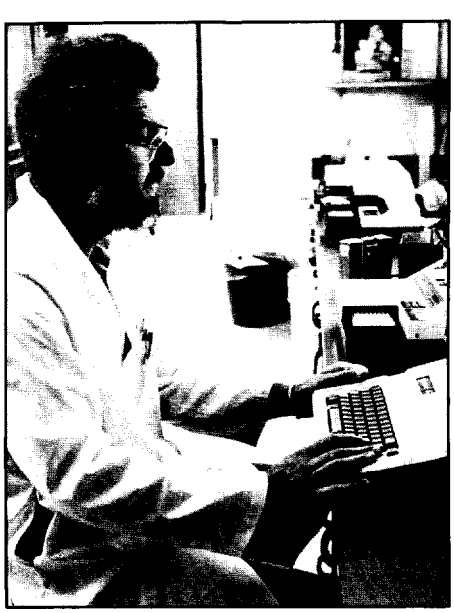
Brood stock culling is a promising approach to the problem but carries a risk of unwanted genetic selection and even the possible destruction of genetic strains of salmon and steelhead. Consequently. researchers are also testing drugs for their ability to block transmission of viral diseases. particularly IHN. The study was completed in 1985.

In a related project (83-304), USFWS biologists are trying to improve methods for detecting and thus laying the basis for preventing the spread of five fish diseases that have an economic impact on salmonid culture in the region: IHN. bacterial kidney disease (BKD). furunculosis. enteric red mouth (ERM) disease, and infectious pancreatic necrosis (IPN).

To accomplish this goal. they are using the enzyme-linked immunosorbent assay (ELISA) test. which can rapidly diagnose infection of either viral or bacterial origin. Activities during 1985 included field testing the BKD ELISA test and developing tests for pathogens causing the other four diseases. The project team will field test these assays during the final phase of the study in 1986. Ultimately, assays will be used to detect disease in hatcheries and wild populations.

Epidemiology and Control of Infectious Diseases of Salmonids in the Columbia River Basin (83-312)

Since 1983. Oregon State University researchers have investigated the geographical range and pattern of occurrence of several viral. protozoan, and bacterial fish pathogens. They are studying methods of estimating disease-induced mortality and morbidity in hatcheries, rivers, and the Columbia River plume of the Pacific Ocean.



Wes Taft

In fiscal year 1985, BPA funded seven projects to directly combat fish diseases.

Biologists have determined that one important pathogen, a parasite called Ceratomyxosis which occurs naturally in the Columbia River. causes far more mortality than was previously suspected. As yet no control is possible.

The project is also investigating bacterial kidney disease and the transmission of the IHN virus, emphasizing prevention and control rather than seeking a cure. Studies are scheduled for completion in 1987.

Pen Rearing and Imprinting of Fall Chinook Salmon (83-313)

U.S. Fish and Wildlife biologists are rearing salmon in net pens and imprinting them to selected backwater locations on the mainstem Columbia. so that when the fish return as adults they will spawn there naturally. In addition to making the best possible use of available backwater spawning areas. this 8-year study will attempt to show that pen rearing is one cost-effective method of artificial salmon production.

The project team surveyed several backwater areas from John Day Dam to Priest Rapids Dam. and selected two areas as primary study sites. Rock Creek and Social Security Pond. These sites have not been adversely affected by hydroelectric development. Team leaders are rearing fall chinook in pens and enclosures at these backwater locations.

If the methodology proves feasible, and adult salmon return to the selected spawning grounds. then the pen rearing technique could be applied throughout the Columbia River Basin. Returning adults will be available for harvest by the Indian fishery, for broodstock in subsequent off-station rearing projects. and for outplanting in nearby rivers and streams.

Development of Diets for Enhanced Survival of Salmon (83-363)

What a young salmon eats in its first months is believed to make a difference in its ability to survive during its long journey to the sea. The Oregon Department of Fish and Wildlife is cooperating with the Oregon State University Seafood Laboratory in a 7-year study to develop a high-quality animal protein diet.

Wes Taft

Researchers are developing a one-day test to detect five major salmon diseases.

Researchers have tested the relative nutritional values of vacuum-dried food on chinook fingerlings. The improved diet can be used in artificial production throughout the Columbia Basin.

ODFW biologists will evaluate the effect of the new diet on the survival and return of coho and chinook salmon. They have tagged selected coho smolts with coded wires for their first and second release years. Diet development continued through 1985. and coded wire tag recoveries will continue through 1989.

Evaluation of Low Cost Salmon Production Facilities (83-364)

Before the Clatsop Economic Development Committee (CEDC) began its Youngs Bay salmon enhancement program in 1976. fishermen caught fewer than 100 fall chinook there each year. In recent years, the annual catch has averaged 5,500. To determine how much the CEDC project has contributed to that increase. researchers are now examining the effectiveness of various project components. They are rearing. tagging, and releasing coho and fall chinook in an experiment to produce large numbers of salmon at low cost while maintaining genetic diversity.

The project team is determining the best density level for juvenile fish reared in a hatchery and comparing the quality of fish produced in a natural pond environment with those reared in concrete hatchery troughs and ponds. They are also assessing whether these methods could be employed at other low-cost salmon production facilities in the Basin. and are exploring the potential for community involvement in such projects.

By its completion in 1988. the study will assess the feasibility of establishing low-cost salmon production facilities as a means to offset Columbia Basin fish losses.

Minthorn Springs Creek Summer Steelhead Juvenile Release and Adult Collection Facility (83-435); Operation & Maintenance of Bonifer Springs Acclimation Facilities (82-18)

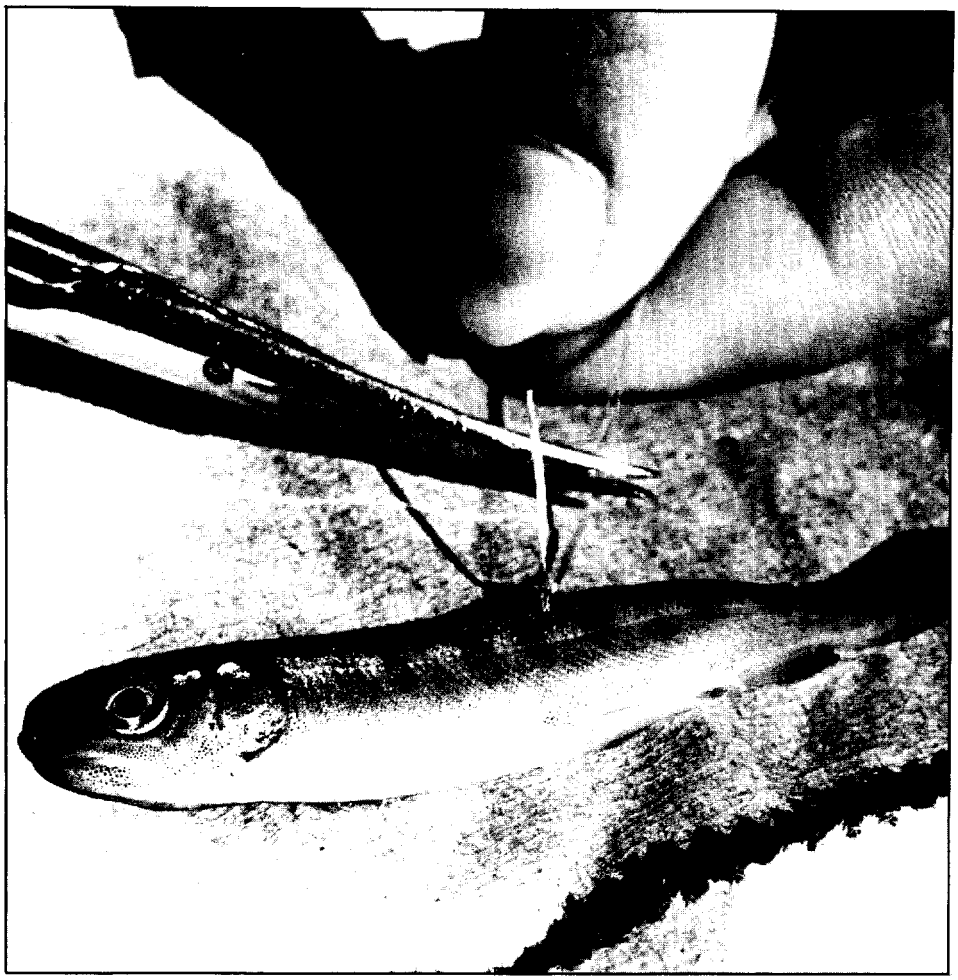
1985 was the second year salmon returned to the Umatilla River after having virtually disappeared for 70 years. Damming the river for irrigation cut off upstream passage to fish and reduced river flows during migration months. Indian and non-Indian fisheries in the Umatilla Basin suffered badly. Large areas of formerly productive natural spawning and rearing habitats remain but are presently unused.

These two BPA-funded projects address the need for on-reservation facilities, linked to off-reservation mother hatcheries. to acclimate and release juvenile steelhead and chinook and collect and hold returning adults for spawning. The projects have helped reestablish the runs. which it is hoped will eventually reach 20.000 chinook and 10,000 steelhead annually.

The Minthorn facility was designed to acclimate 150.000 steelhead smolts and hold up to 250 adults. It also has the flexibility for acclimation and adult holding of chinook salmon as well as potential for short-term rearing of both salmon and steelhead.

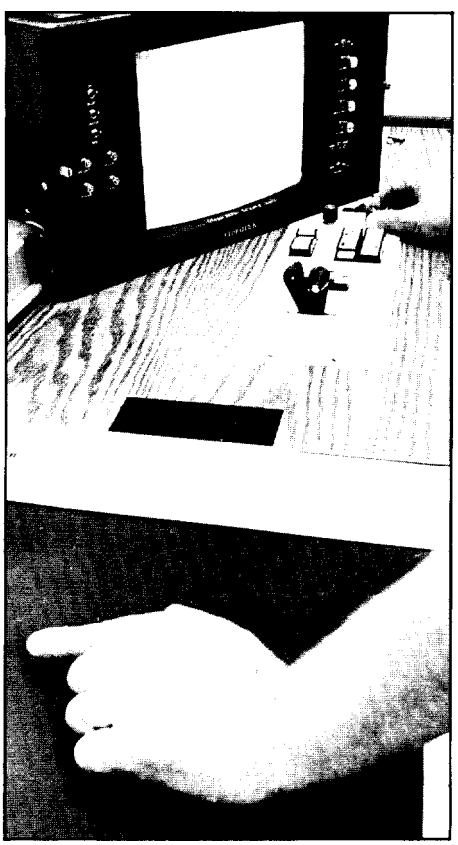
Adults returning in 1985 were released as smolts by the Umatilla Tribes and Oregon Department of Fish and Wildlife between 1982 and 1984. The fish were hatched at Bonneville Hatchery and transported by train to the Minthorn and Bonifer Springs facilities for imprinting. The first returning adults will be used as brood stock. The 1985 run is a breed of chinook called upriver brights. The previous fall. a run of tule chinook returned, the first major run of salmon to enter the Umatilla River since 1914.

Wes Taft



Laboratory research shows how well young fish can withstand the stress of life in the reservoirs.

Wes Taft



A scientist shows where bacteria have penetrated a salmon cell wall.

Stock Identification of Columbia River Chinook Salmon and Steelhead Trout (83-451)

Oregon State University researchers are characterizing each wild and hatchery stock (i.e., unique species, strain, or race of fish) in the Columbia by morphological. behavioral, physical, and biochemical traits such as run timing, migration habits, fecundity, disease resistance, and various enzymes.

Results will help hatchery and fishery managers protect the genetic integrity of Columbia chinook salmon and steelhead trout. Data will be used in selecting donor stocks for hatchery programs and supplementing wild populations.

Biologists are sampling fish over a 3-year period at more than 80 hatcheries in Oregon, Washington, Idaho, and Montana, and in 30 rivers in the Columbia and Snake River systems. The project will be completed in 1986.

Wes Tatt

Researchers believe improving fish health is critically important to increasing salmon and steelhead runs.

Protection of Wild Adult Steelhead in Idaho by Adipose Fin Removal (84-2)

Steelhead reared in hatcheries in the Snake River produce harvestable surpluses. If fishing is allowed, there is a great danger that already threatened wild steelhead stocks would be further depleted. However, it would be possible to protect wild fish stocks if they could be easily distinguished from hatchery fish.

Idaho Department of Fish and Game is marking some 6 million hatchery fish a year by surgically removing the adipose fin. The operation apparently does not cause significant adverse effects and provides an easily recognizable mark. The goal of the study is to remove the adipose fin from 99 percent of all hatchery fish in Idaho and evaluate the impact of the procedure on the well-being and survival of the fish.

Umatilla River Summer Steelhead Hatchery (84-33)

The goal of this project is to construct a hatchery facility capable of rearing 200,000 summer steelhcad smolts for annual release into the Umatilla River via the Minthorn and Bonifer Springs acclimation facilities. The hatchery will help make up for fish losses resulting from hydroelectric development. A separate project will estimate the potential benefits from the hatchery releases. Three sites in the Irrigon area are currently under consideration. and siting and predesign studies will continue through 1986. Construction is scheduled to begin in 1987.

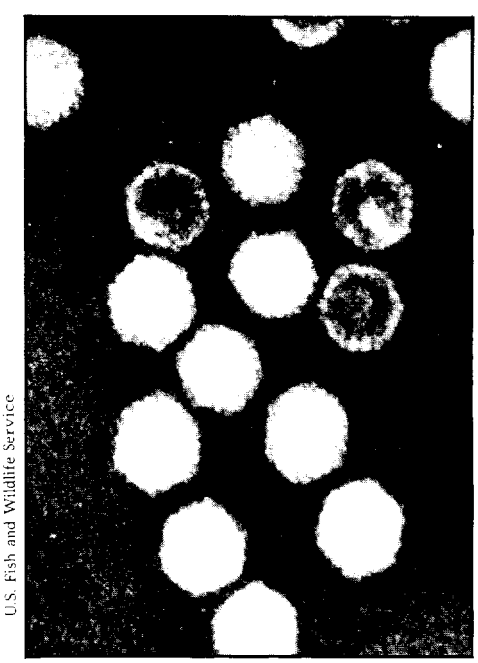
Development of a Subunit Vaccine Against IHN (84-43)

This project is investigating how to produce a previously developed subunit vaccine against the IHN virus through genetic engineering. IHN-specific proteins will be produced by bacterial clones and used to induce immunity to IHN in salmon and steelhcad. Experiments with hatchery fish and also with laboratory-reared rainbow trout, steelhead trout, and sockeye salmon will determine how effective induced immunity is in protecting the fish. Biologists are also evaluating various methods for immunizing fish against IHN and developing protocols for vaccine production through evaluation of various cloning processes.

Etiology of Early Lifestage Diseases (84-44)

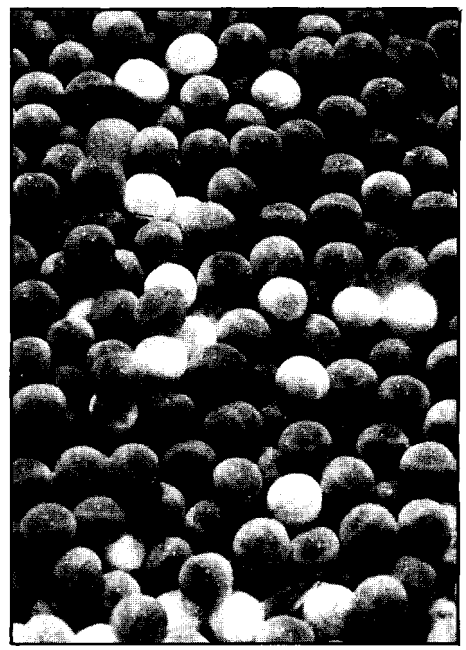
Maternally transferred pathogens are particularly troublesome because their presence in the developing embryo tends to give its immune system the false impression that they are "self" or part of the fish. As a result, the host will usually not fight the disease.

Recent research has shown that bacterial kidney disease and IHN arc transferred maternally to the egg yolk. Project data has revealed numerous gram-positive and gram-negative bacteria in the yolk of developing eggs and sac-fry. Enteric red mouth disease has also been tentatively identified in the yolk material.



U.S. Fish and Wildlife Service

A cross-section of IPN infections pancreatic necrosis/ virus magnified 500,000 times.



Ron Smith

Chinook salmon eggs in an early stage of development.

These maternally transferred bacteria have been associated mostly with chinook salmon but may also account for significant mortality in other salmon species and steelhead. This 2-year project by Oregon Health Sciences University will isolate and identify additional pathogens in salmon eggs, characterize their induced pathology, determine levels of endotoxin (a bacterial product toxic to the fish host), and investigate remedial actions.

The result will be a better understanding of which diseases are maternally transferred and of the implications of shipping salmon eggs to new locations.

Influence of Vitamin Nutrition on the Immunity Response of Hatchery-reared Salmonids (84-45)

Increased levels of certain vitamins help protect man and domestic animals from infectious diseases. Now there is evidence this is also true of hatchery-reared fish. This aim of this study is to establish the amounts of six vitamins — C. B6, E. folic acid, pantothenic acid, and riboflavin — required to optimally protect Columbia Basin salmonids from disease.

OSU and the U.S. Fish and Wildlife Service project team is also developing recommendations on how to manufacture, store, and handle practical, economical. vitamin-enriched fish feeds to be used at hatcheries. The outcome of their work, to be completed

in 1989, should be a better. more economical salmon diet, more adult hatchery reared salmon, and more efficient mitigation for losses from hydroelectric development.

Evaluate Vaccines for Bacterial Kidney Disease in Salmon (84-46)

Bacterial kidney disease infects large numbers of hatchery-reared salmon and trout, causing heavy losses. In an effort to combat this deadly disease, Oregon State University microbiologists are examining the components of the bacteria responsible and testing their ability to induce immunity against BKD.

They are also assessing intercellular antigens by testing them both in natural molecular form and in chemically modified forms that will increase immunity. Researchers will rank the antigen preparations by effectiveness. cost of vaccine production, and technical difficulties involved.

The final report, expected in 1986, will fully describe production protocols and give suggestions for large-scale vaccine production for each antigen proved capable of providing a significant degree of protection against BKD.

Willamette Spring Chinook Study Plan (85-68)

Oregon Department of Fish and Wildlife researchers are conducting this study to determine the most effective methods for supplementing natural stocks of spring chinook in the Willamette River system with hatchery-produced fish.

They have reviewed all existing literature on the subject. In field experiments, they will introduce hatchery-reared spring chinook into natural streams as adults, fry or presmolts, to evaluate the production obtained.

The study will also determine whether hatchery supplementation of wild stock will establish self-perpetuating runs, or if continuing hatchery support is necessary. Phase I of the study was completed in 1985.

Electrophoresis Genetic Stock Identification Project (85-84)

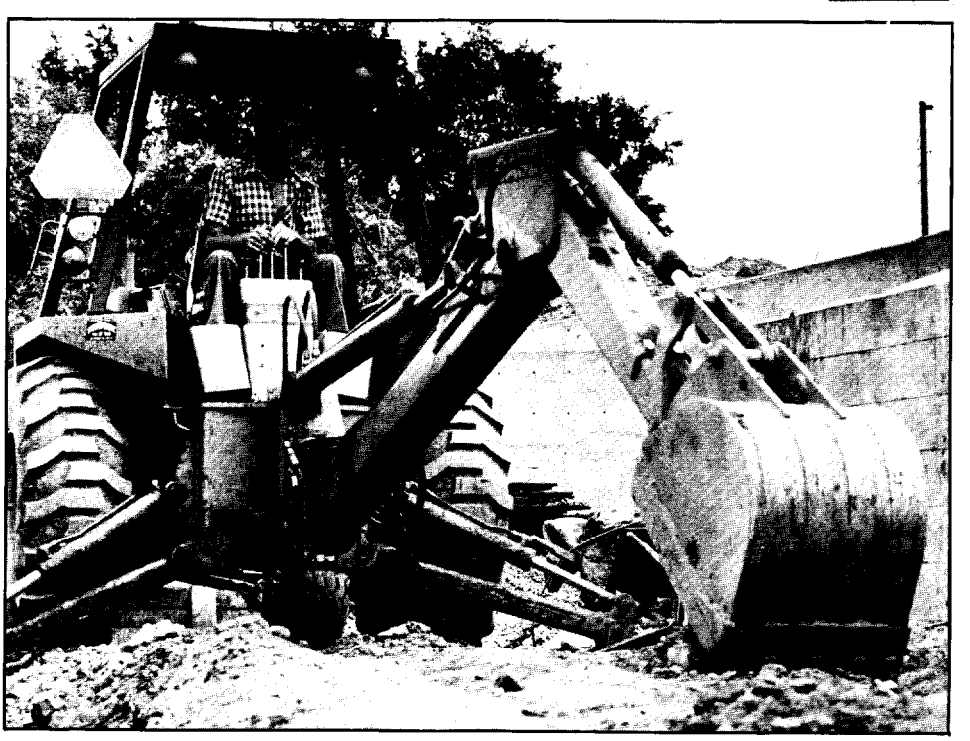
Genetic stock identification (GSI) is a practical and functional tool for estimating the contributions of chinook stocks to both river and ocean mixed stock fisheries. The basis of the method is to detect genetic differences between stocks. The technique used is called electrophoresis. a method of examining differences between proteins by measuring their electrical charge.

Once a stock's genetic profile is established, its annual contribution to a fishery can be determined with minimal rcsampling. The method is unique in providing a comprehensive view of the contribution of both hatchery and wild stocks to mixed fisheries.

The study was completed by the National Marine Fisheries Service in 1985.

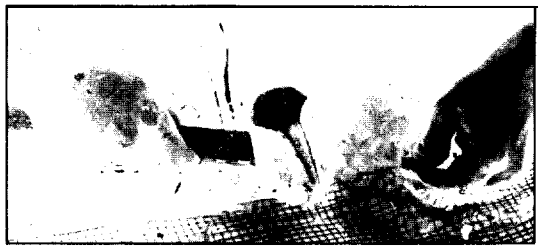
Wes Tatt

Biologists are engineering virus clones for use as vaccines.

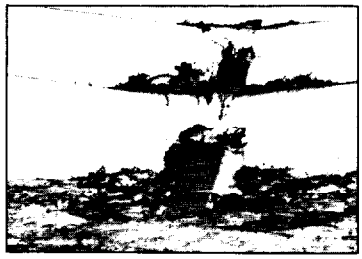


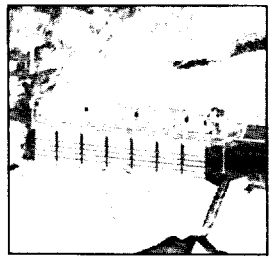
Sharon Blair

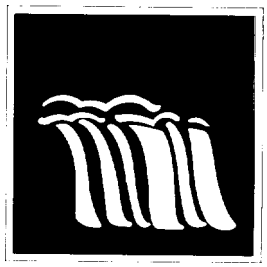
A contractor clears the site for the Minthorn Springs acclimation pond on the Umatilla Indian Reservation



HABITAT ENHANCEMENT AND PASSAGE IMPROVEMENT







Hydroelectric development has destroyed or cut off hundreds of miles of the spawning and rearing habitat of wild salmon and steelhcad in the Columbia and Snake Rivers. In addition, the routine operation of the dams, which among other things causes water fluctuations during peak power demand, can also continue to disrupt natural propagation.

Reestablishing wild fish populations and rebuilding their spawning and rearing habitat is a major element in mitigating losses resulting from hydroelectric development. Propagation of wild fish has been an important part of BPA's program since 1978, when a study in the John Day River began.

Natural selection exerts very strong pressures on fish that spawn in the wild, and only the hardiest survive. As a result, resilient. diverse stocks evolve over time, adapting to the unique conditions in their home stream. This genetic diversity is essential to the vigor and even survival of a species, but it cannot be maintained without a suitable environment.

Each species has special habitat requirements for each stage of its life. The quality, quantity, and location of gravel, rocks, and boulders determine to a large extent whether salmon and steelhead can use a stream as their home. Rocks help oxygenate the water, provide habitat for aquatic insects that are an important food source, and create the whitewater where juvenile fish can hide. Streamside areas – the riparian zone – are also important to the health of a stream. The roots of streambank vegetation prevent erosion, while overhanging branches shade and cool the waters in summer.

Anadromous fish habitat has declined drastically since settlers first arrived in the Pacific Northwest. Soil erosion brought thick sediment to streams, livestock overgrazed streamside vegetation, then logging and irrigation took their toll. and finally hydroelectric development and dam construction blocked off many of the streams where salmon and steelhead originally spawned. Combined, man's activities have eliminated as much as 75 percent of the region's fish habitat since the turn of the century, contributing to an 80 percent decline in wild runs.

Despite these damaging influences, stretches of many tributary streams offer ideal spawning grounds and rearing habitat at present either unused or underused by wild fish. Some of the areas are unreachable because of natural or manmade obstructions. Other sites need improvements to bring existing natural habitat up to full productive potential.

BPA funded the following projects during 1985 to enhance existing spawning and rearing habitat. to improve dilapidated or non-functional fish passage facilities, or to build new fishways to open up the remaining undisturbed sites to migrating fish, Most of these projects arc on undammed tributaries, offsite from the Federal dams on the mainstem Columbia.

Habitat Enhancement and Passage lmprovement: Project Descriptions

Study of Wild Spring Chinook in the John Day River System (79-4)

Habitat Quality and Anadromous Fish Production Potentials on the Warm Springs Indian Reservation (81-I08)

A Biological and Physical Inventory of the Streams within the Nez Perce Reservation (82-1)

Snake River Fall Chinook Brood Program (82-7)

Yakima River Spring Chinook Enhancement Study (82-16)

Idaho Habitat Evaluation for Offsite Mitigation Record (83-7)

Stock Assessment for Columbia River Basin (83-335)

Hood River Passage (83-34l)

Anadromous Salmonid Spawning and Rearing Habitat in Bear Valley Creek (83-359)

Forest Service Natural Propagation and Habitat Improvement Projects (83-415, 84-5, 84-8, 84-11, 84-24)

Trout Creek Natural Propagation Enhancement (83-423, 84-7, 84-62)

Lower Umatilla River Channel Modifications Below Three Mile Falls Dam (83-434)

Three Mile Falls Diversion Dam Fish Passage Facilities, Umatilla River (83-436)

Evaluation of Lower Umatilla River Channel Modifications below Three Mile Falls Dam (83-834)

Clearwater River Habitat Enhancement (84-6)

A Planning Aid for the Rehabilitation of Anadromous Fish Stocks in the Umatilla River Basin (84-10)

Joseph Creek, Grande Ronde River, Oregon (84-9, 84-25)

Main Stem, Middle Fork John Day River, Oregon (84-21)

John Day Habitat Enhancement (84-22)

Camas Creek, Idaho (84-23)

Middle Fork and Upper Salmon River Enhancement Project (84-24)

Lemhi River Habitat Enhancement Project (84-28)

Panther Creek Habitat Enhancement Project (84-29)

TumwaterlDryden Dams Fish Passage and Environmental Assessment (85-52, 85-53, 85-86)

South Fork John Day River/Izee Falls (85-71)

Pacific Northwest Rivers Study (84-40)

Evaluate Procedures by Which Migrating Adult Salmon and Steelhead Are Counted and Accounted for, and Compile all Available Information on "Losses" between Projects (84-42)

Study of Wild Spring Chinook in the John Day River System (79-4)

The John Day River system supports one of the few totally wild runs of spring chinook in the Columbia Basin. The genetic integrity of these wild stocks has to be maintained, but runs have been declining for more than 10 years.

The Oregon Department of Fish and Wildlife undertook this study to achieve several related goals. The first is to define the number of John Day spring chinook that have to escape capture to produce the largest harvestable surplus of adults. Researchers will then recommend harvest regulations to achieve the most favorable escapement levels.

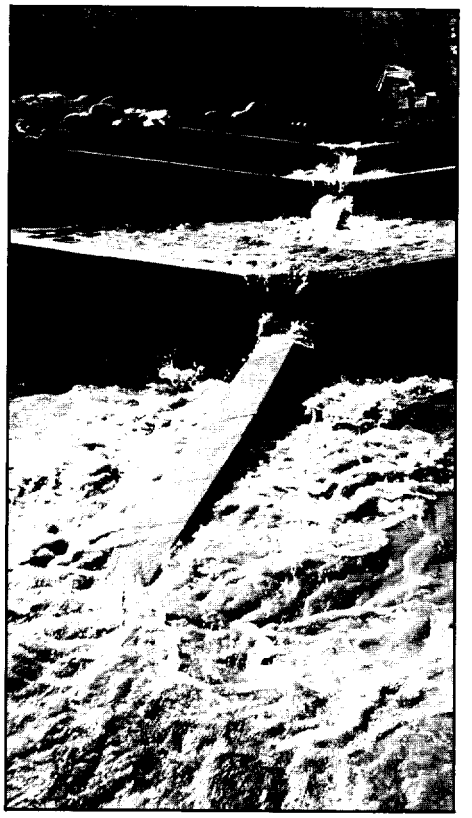
By coordinating studies with those of other agencies, they will also determine whether both upstream and downstream fish passage operations at Columbia River dams need to be adjusted to increase the survival of John Day migrants.

Finally, ODFW biologists will recommend habitat and/or environmental improvements in the John Day system that will increase production of wild spring chinook smolts. They will also recommend operational procedures for augmenting production with hatchery stock if it becomes necessary to artificially maintain this wild run. The project was completed in late 1985.

Habitat Quality and Anadromous Fish Production Potentials on the Warm Springs Indian Reservation (81-108)

The Natural Resources Department of the Confederated Tribes of Warm Springs began this project in 1981 to improve habitat and passage for salmon and steelhead on reservation streams and rivers. Tribal biologists also are evaluating potential spawning and rearing areas and calculating the number of adults that must escape to seed the available habitat.

In 1985, the team continued to identify habitat and passage problems and completed a plan for habitat improvements on a channelized segment of Beaver Creek.



Sharon Blair

New weirs to pass adult fish over Hood River Falls could mean 2,000 more steelhead each year for the Columbia.

Tribal biologists have finmarked several brood years of spring chinook fingerlings for release at the Warm Springs National Fish Hatchery and, in the final years of the project when habitat and passage improvements are completed, they will evaluate the success of the project by analyzing returning adults from finmarked releases.

A Biological and Physical Inventory of the Streams within the Nez Perce Reservation (82-l)

As part of the effort to rebuild their salmon and steclhead fisheries, which have suffered drastically from hydro development, the Nez Perce Tribes of Idaho are preparing an inventory of both the physical habitat in reservation streams and the associated biological community.

During 1985. they finished identifying factors that limit fish production, such as heavy sedimentation, high summer water temperatures, low flows, and barriers to migration. The tribe will use this information to select the most appropriate enhancement efforts for each stream in the reservation. The study will conclude in 1986.

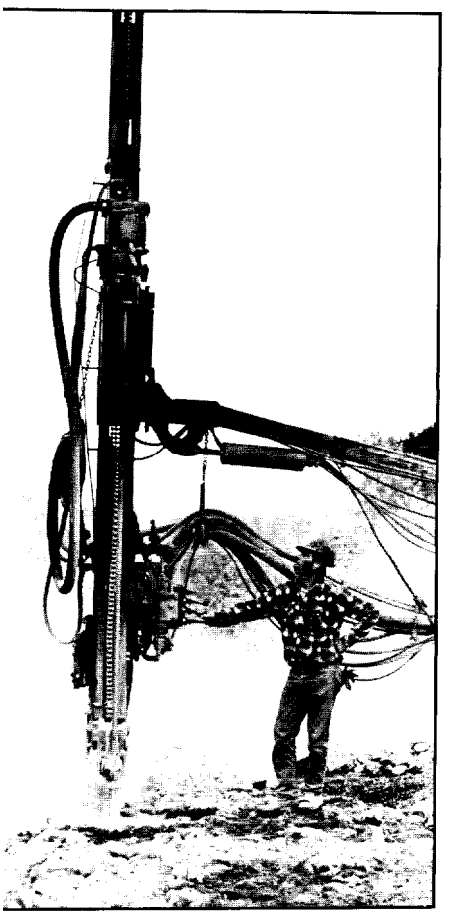
Snake River Fall Chinook Brood Program (82-7)

The Snake River fall chinook population has declined to critically low levels. To preserve the unique genetic traits of this upper river run, the National Marine Fisheries Service started an experimental fish farm to produce some of the eggs needed by Snake River hatcheries. The goal was to produce 8.5 million eggs annually by 1987.

A newly identified disease has killed most of the fish reared under this project. Given the severe disease problem, the brood stock program will be terminated in 1986.

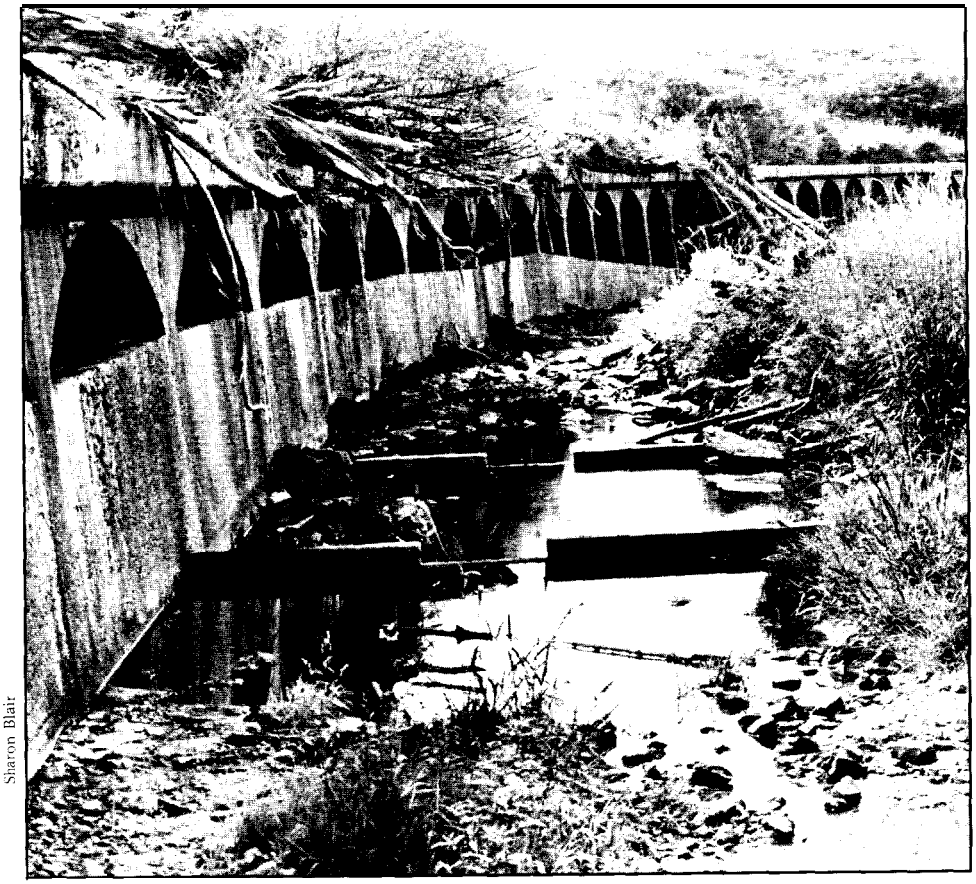
Yakima River Spring Chinook Enhancement Study (82-16)

Yakima River spring chinook have declined dramatically, due to overharvest, withdrawal of water for irrigation, and downstream hydro development. Yakima Tribe fishery researchers have started the restoration effort by estimating the numbers and distribution of naturally produced fry and smolts in the river.



Sharon Blair

A contractor drills holes for blasting a fish passage channel to the lower Umatilla River.



Sharon Blair

Three Mile Dam a major obstruction to migratory fish passage on the Umatilla River.

They are evaluating different methods of introducing fry and smolts into the natural rearing environment. Next comes the task of locating and defining areas of the watershed suitable for rearing spring chinook, then the project team will develop strategies for enhancing the fishery and prepare guidelines for compensating for fish losses in the Yakima Basin. The study is due for completion in 1990.

Idaho Habitat Evaluation for Offsite Mitigation Record (83-7)

To produce an offsite mitigation record for Idaho, the State's Department of Fish and Game is evaluating what benefits habitat improvements bring to juvenile salmon and steelhead production in the region. Biologists measure basic parameters such as smolt production and relate the figures to construction and operating costs per mile over each project's useful life.

They are evaluating nine projects, all built by the U.S. Forest Service and the Shoshone-Bannock Tribes in cooperation with the IDFG. The Idaho offsite mitigation record is prepared annually, though individual projects are monitored only at intervals through 1988.

Stock Assessment for Columbia River Basin (83-335)

Pacific salmon and steelhead are divided into groups, or stocks, which are genetically and behaviorally distinct. In the past, hatcheries have often failed to observe the distinctions and have changed the genetic composition of most salmonid stocks far more rapidly than would occur by natural evolution.

This project, a multiagency effort, assessed all existing Columbia Basin wild and hatchery salmon and steelhead stocks. Complete data on the different stocks will help hatchery managers determine which stocks are most suitable for mitigation and enhancement programs.

Biologists from the Oregon Department of Fish and Wildlife, Washington Department of Fisheries, and Washington Department of Game compiled and summarized information from existing literature and historical studies.

They examined hatchery records, fin-mark and coded wire tag studies, and dam counts to build a complete life cycle profile of each hatchery stock. Though much information was available for hatchery stocks, the same was not true for most wild stocks. Researchers identified and characterized wild stocks using spawning ground survey data and fishing records. The results of the surveys have been published in a final report, summarizing the information by stock and providing complete literature references.

Hood River Passage (83-341)

Man-made barriers are not the only obstacles fish meet when trying to return upstream to spawn – nature can also block their path. An example is a natural waterfall on the West Fork of the Hood River, which cuts off adult salmon and steelhead from more than 23 miles of potential habitat. In recent years, hundreds of fish would hold up in a pool at the base of the falls, easy pickings for illegal fishing.

Oregon Department of Fish and Wildlife engineers developed a final design for a fish passage facility that could double the salmonid stocks in the river by allowing more than the current 20 percent to complete their spawning run upriver. Work crews have completed construction of the facility, a huge fish ladder taking up the whole streambed from bank to bank. Ten weirs from 8 to 15 feet high and 32 feet wide create a giant stairway for migrating fish, turning the falls into a gentle cascade.

Dennis Maxwell

A worker tacks hardware cloth onto a log weir to help trap gravels and create a new spawning site.

Anadromous Salmonid Spawning and Rearing Habitat in Bear Valley Creek (83-359)

Bear Valley Creek, a tributary of the Upper Middle Fork of the Salmon River in central Idaho. is a valuable area for natural production of salmon and steelhead but has been degraded by past mining and dredging operations.

The Shoshonc-Bannock Tribes have formed a task force of tribal, State. and Federal representatives to cooperate in enhancing the habitat for increased fish production. Tribal researchers are performing a habitat inventory and preparing cost estimates. They are also evaluating possible enhancement measures. such as arresting lateral channel movement and sedimentation. while coordinating the work with Federal and private landowners.

Though the Bear Valley Creek degradation is unrelated to hydroelectric development or operation, benefits will still be considered as offsite mitigation for mainstem fish losses. By 1988. the project will grow to encompass other enhancement measures, including projects at Yankee Fork and Jordan Creek.

Forest Service Natural Propagation and Habitat Improvement Projects (83-415, 84-5, 84-8, 84-11, 84-24)

Potential spawning and rearing habitat can often be found on Federal lands. It such sites were originally damaged by hydroelectric development or are appropriate for offsite mitigation, BPA may contract with the agencies involved to make improvements. In 1984 BPA funded one continuing and four new projects with the U.S. Forest Service.

The Sawtooth National Forest plans to augment instream flows below the Alturas Lake Creek diversion dam (83-415). The stream was once a prime spawning site for salmon, but inadequate stream flows have reduced natural production. Increasing the flows would allow fish to reach upstream spawning grounds and would also improve both the quality and quantity of spawning and rearing habitat below the dam.

USFS researchers will outline the alternative approaches to ensure adequate instream flow when they complete the study in 1986.

Nez Perce National Forest engineers are replacing a culvert so that salmon and stcelhead can reach upstream spawning areas on the Crooked River (84-S). They are also improving habitat on the upper Crooked River. The measures are expected to improve natural fish production considerably.

USFS is also cooperating with Idaho Department of Fish and Game and local landowners to improve Red River habitat by installing stream structures to protect the river banks and by planting trees and shrubs to stabilize the banks and shade the young fish. Fencing the streamside areas on private ranch land will encourage the growth of plants that provide cover for juvenile fish. The project. scheduled for completion in 1988, could increase production potential to three or four times the current levels.

Sharon Blair

Blasting a channel in the lower Umatilla River bedrock

Umatilla National Forest (84-8) completed the repair of historic mine dredging damage in Granite and Clear Creeks. The dredging began in the 1920s and continued intermittently until 1954, disrupting riparian and instream habitat and displacing spawning gravel. As a result. salmon and steelhead populations have declined considerably. USFS began the rehabilitation in 1979, adding 7100 cubic yards of grave1 to spawning areas along a 4-mile stretch of Clear Creek. Foresters installed log and boulder weirs to increase gravel-collecting pools, stabilized stream banks, and plugged the Blackjack Mine and diverted its seepage. During 1985, they planted shrubs and relocated boulders on Clear Creek, expanded habitat and stabilized banks on Granite Creek, and opened blocked side channels for fish rearing in the North Fork, John Day River. Oregon Department of Fish and Wildlife will monitor project results.

Mount Hood National Forest biologists are improving passage and habitat for coho salmon and winter and summer steelhead in several creeks in the Northern Cascades (84-11). At Fish and Wash Creeks, they have reestablished an off-channel coho rearing pond and built 11 instream structures to trap gravels. On Lake Branch Creek. crews are removing logjams and installing gravel-trapping structures, hoping to double fish production.

There are plans for a fish passageway at Collawash Falls to give access to 8.4 miles of habitat in the upper Collawash River. This project will be completed by 1987.

USFS and BPA are cooperating in the planning and will share the funding of habitat improvements in Marsh, Elk, and Bear Valley Creeks on the upper Salmon River in Idaho (84-24). Heavy livestock grazing. irrigation diversions, and natural sedimentation have degraded the salmon and steelhead habitat on these streams.

Biologists are evaluating potential habitat and estimating possible population levels. They will recommend appropriate improvements, such as fencing, stream bank stabilization, and instream structures. BPA and USFS will then develop a cost-sharing agreement to implement these recommendations. Work should be completed by 1988.

Trout Creek Natural Propagation Enhancement (83-423, 84-7, 84-62)

Salmon and steelhead are two of the most abundant and valuable fish in Trout Creek in central Oregon, but the populations are limited by irrigation withdrawals and stream channelizations that result in low summer flows. high

water temperatures, unstable banks, and few spawning pools. Overgrazing on stream banks and stream channelization has also depleted vegetative cover.

Northwest Biological Consulting has completed preparation of a preliminary habitat enhancement plan and feasibility study (83-423). The U.S. Soil Conservation Office (84-7) and Oregon Department of Fish and Wildlife (83-62) continued work on the final phase of the Trout Creek natural propagation project. which includes landowner coordination, economic analysis, and completion of the final plan to increase fish runs.

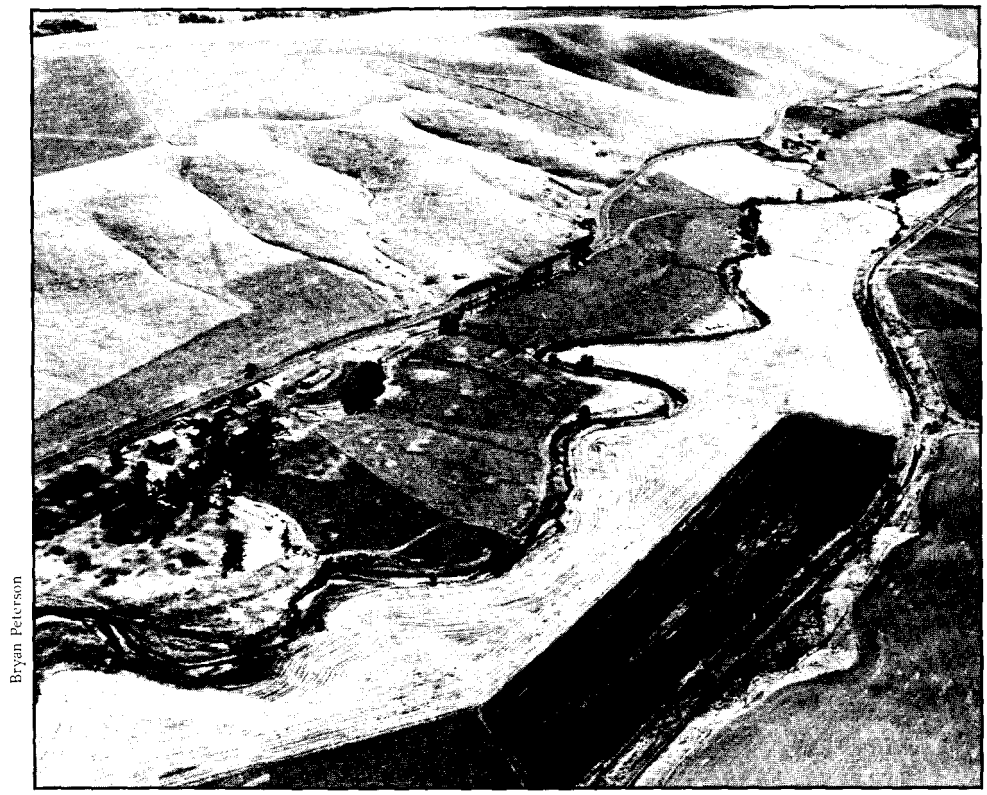
The Trout Creek watershed could be a tnajor tributary system for the production of wild salmon and steelhead. The basin currently only supports a summer run of 250 steelhead because of degraded habitat. These fish only use 40 miles of stream, leaving another 100 miles virtually unused.

Three Mile Falls Diversion Dam Fish Passage Facilities. Umatilla River (83-436);
Lower Umatilla River Channel Modifications Below Three Mile Falls Dam (83-434);
Evaluation of Lower Umatilla River Channel Modifications below Three Mile Falls Dam (83-834)

Three Mile Falls Dam on the Umatilla River is a significant obstruction to salmon and steelhead migrating to spawning grounds in the upper Umatilla River Basin. The spill flow pattern creates false attraction that draws fish away from fish ladder entrances. In low water years, the resulting migration delay and stranding, along with other problems such as poaching and poor water quality, seriously limit steelhead production in the area. Improperly screened diversions cause high mortality among downstream migrants, further compounding the problem. Over the years. steelhead runs have declined from several thousand to as low as 750, and the salmon runs had disappeared completely until recently.

Dennis Maxwell

Water - source of life for man, industry, farmer and fish.



Bryan Peterson

The Umatilla Basin, where water turns prairie into productive cropland.

The U.S. Bureau of Reclamation, in cooperation with other agencies, is developing final designs for solving passage problems and for adult collection and counting facilities at the dam (83-436). Bureau engineers will replace the east bank ladder with a model that can handle winter flows. For fish passage the rest of the year, they will renovate the west bank ladder, dredging the dam so fish can find the ladder, and add a trapping facility at the top. ODFW will trap and haul adult salmon past the four diversion dams above Three Mile Falls Dam. Construction will be completed in 1989.

Another project to improve fish passage to the dam was undertaken in 1984 by the U.S. Army Corps of Engineers (83-434). Engineers modified the lower Umatilla River channel below the dam to allow fall chinook to pass at low flows when blind channels. bedrock drops, and streamwide riffles impede passage. The Corps blasted a trench in the riverbed to connect channels, remove outcrops, and concentrate enough water to allow fish to move up the trench to the dam.

BPA then funded a study by Oregon Department of Fish and Wildlife to evaluate fish passage through the modified channel (83-834). First year results indicated that steelhead migration in November and December was not seriously impeded by flows in the lower river. Biologists are currently studying the movements of 1981 and 1982 broods of fall chinook. The objective is to determine the flows at which the largest number negotiate the channel modifications and enter at Three Mile Falls Dam.

Clearwater River Habitat Enhancement (84-6)

El Dorado Creek has a series of natural basalt falls barring upstream passage to spring chinook and steelhead. To allow migration to some 10 miles of spawning and rearing habitat, U.S. Forest Service workers have blasted out the barriers and built stairstep pools at the lowermost falls.

A Planning Aid for the Rehabilitation of Anadromous Fish Stocks in the Umatilla River Basin (84-10)

Oregon Department of Fish and Wildlife undertook this study to evaluate potential projects that could be implemented to enhance and protect anadromous fish runs in the Umatilla Basin. The overall goal is to establish objectives for a rehabilitation program for both wild and hatchery fish, including population, harvest, and escapement requirements for each species and stock recommended.

Researchers will specify the benefits and costs of each preferred project and alternative under two sets of conditions: when only existing instream flows are available: and when recommended minimum instream flow requirements can be met.

Joseph Creek, Grande Ronde River, Oregon (84-9, 84-25)

Suitable rearing habitat for summer steelhead is severely limited in large portions of the Grande Ronde River/Joseph Creek drainage by high summer water temperatures. These high temperatures are due to a lack of streamside vegetation, which would provide shade, and a lack of deep pools. This project aims to develop optimum habitat on over 120 miles of stream.

The project is being carried out in three phases: prework survey and design: implementation, including protection of streamside vegetation, planting of shrubs and plants to increase shade, and installation of instream structures to improve pool/riffle ratios; and postwork monitoring and maintenance.

These habitat improvements, coupled with correction of downstream passage problems, should increase the number of spawning adults by 4,000 annually within 10 years of completion in 1988.

Main Stem, Middle Fork John Day River, Oregon (84-21); John Day Habitat Enhancement (84-22)

The John Day River's wild chinook run and hatchery-supplemented steelhead trout runs have been depleted by fish losses at mainstem Columbia River hydro projects. Various other water uses unrelated to hydropower have also affected these runs. If corrected, they could contribute much to offsetting losses at mainstem dams.

Dennis Maxwell

Foresters rework Fish Creek, a tributary of the Clackamas River, to improve coho salmon habitat

This ODFW project (84-21) implements enhancements on the Main Stem. Middle Fork, and North Fork of the John Day. Activities include increasing the number of rearing pools, creating holding areas for adult fish, rebuilding old stream channels damaged by mining in the 1940s and other habitat and streamside improvements. The project runs through 1988.

The U.S. Forest Service is also working on habitat improvements and passage development projects on sections of the John Day River and tributaries that run through Malheur National Forest (84-22). Foresters have installed log and boulder structures along the stretches of mainstem stream where salmon and trout spawn to improve the quality and quantity of pool habitat. During 1985, they completed surveys of the Middle Fork and other tributaries and prepared designs for similar enhancement projects.

Camas Creek, Idaho (84-23)

Heavy livestock grazing has degraded the channel and streamside habitat of Camas Creek, a 38-mile long tributary of the Middle Fork Salmon River in Idaho. In 1985, U.S. Forestry Service researchers completed a feasibility study and plan to enhance salmonid spawning and rearing habitat. Phase II activities, which will continue through 1988, include fencing and reintroduction of riparian plant species to stabilize stream banks and provide cover.

Middle Fork and Upper Salmon River Enhancement Project (84-24)

The U.S. Forest Service is implementing measures to increase salmon and steelhead spawning in streams in portions of the Boise. Challis, and Sawtooth National Forests to make up for fish losses at downstream Columbia dams. The preliminary phase was completed in 1984, which included habitat and fisheries inventories, and identification of habitat problems. Project implementation will be complete by 1988.

Lemhi River Habitat Enhancement Project (84-28)

Large portions of the Lemhi River in Idaho are diverted for irrigation, adversely affecting salmon and steelhead rearing and adult passage. This study by OTT Water Engineers is

to identify problem areas on the river, evaluate fishery potential, and develop recommendations for enhancing fish production. The construction phase of the project is scheduled for completion in 1988.

Panther Creek Habitat Enhancement Project (84-29)

Deer and Blackbird Creeks carry toxic effluent from abandoned mines into Panther Creek, a tributary of the Middle Fork, Salmon River. Records dating from 1963 to the present show that spring chinook salmon and steelhead runs have declined to extremely low levels due to the passage problem.

This feasibility study by Bechtel Corporation is to evaluate the potential habitat that the streams offer and to recommend alternatives for adding 100 miles of productive habitat as offsite mitigation. The feasibility study will be completed in 1986. Implementation will occur through 1988.

Tumwater/Dryden Dams Fish Passage and Environmental Assessment (85-52, 85-53, 85-86)

Dryden and Tumwater dams are located in central Washington on the Wenatchee River. The Dryden dam, built in the early 1900s as a diversion for irrigation flow and later for hydropower, originally had fish ladders on both banks. The left bank ladder was washed out by the 1948 flood and never replaced; the right bank needs a complete rehabilitation. The Tumwater fish ladder, last worked on in the 1940s, is similarly in need of a complete overhaul. Earlier studies indicated new structures would significantly reduce upstream passage problems. OTT Water Engineers is preparing an Environmental Assessment on both projects, due for completion in 1986. Final design and construction will begin in the Summer of 1986 and are scheduled for completion in 1987.

South Fork John Day River/lzee Falls (85-71)

The South Fork John Day River drainage contains approximately 85 miles of accessible summer steelhead spawning habitat. Among the factors limiting wild steelhead propagation are the poor quality and limited quantity of pool habitat, low summer flows, and high water temperature. Wild summer steelhead production in the river could be enhanced by increasing the quality. quantity, and diversity of pool habitat for 10.5 miles of stream below Izce Falls. The Bureau of Land Management is placing 1500 boulders in the river to improve pool habitat. Construction is expected to be completed in 1987.

Dennis Maxwell

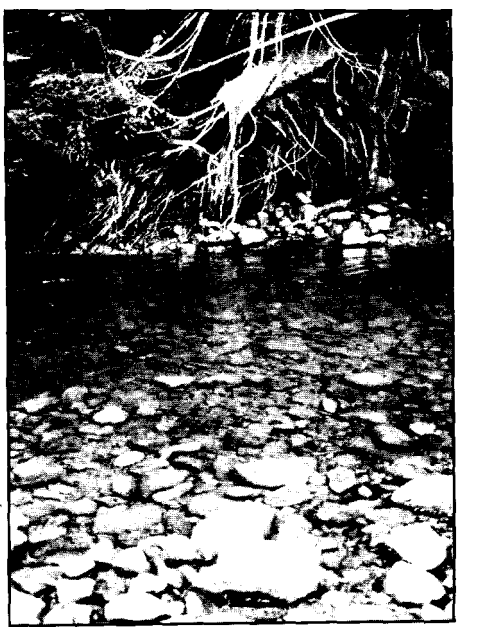
Habitat improvement in *Idaho's Red River could increase fish production fourfold*

lzee Falls blocks upstream passage of wild summer steelhead into about 81 miles of potential spawning and rearing habitat. This project will also provide access to these areas and thus increase the production potential of wild summer stcelhead in the river. Work on this part of the project is expected to begin in 1986.

Pacific Northwest Rivers Study (84-40)

Large-scale hydroelectric projects have long been the dominant features of the Pacific Northwest's rivers, but attention has more recently focused on the use of rivers as producers of small-scale hydro power. In 1978. fewer than 20 active applications for hydropower permits were processed nationwide by the Federal Energy Regulatory Commission. Since that time, largely as a result of Federal and State economic incentives, nearly 6,000 applications have been filed nationally– one quarter of them in the four-State region of Idaho, Montana, Oregon, and Washington.

This activity has intensified public awareness of potential conflicts between small-scale hydro development and other river values, including wildlife, natural features, cultural features, and


Bryan Peterson

Roots trap soils, creating the foundation for a healthy riparian zone.

recreation. In response, the Northwest Power Planning Council initiated a regionwide Hydro Assessment Study in 1984. The study has four components: the development of a hydropower site data base; an anadromous fish assessment; an Indian cultural site assessment; and an environmental values assessment.

The environmental values assessment was organized into a distinct study called the Pacific Northwest Rivers Study. This is a cooperative effort by the region's four States, Indian tribes, and Federal resource management agencies to evaluate and document the relative environmental significance of the region's rivers and streams.

Study results will help BPA in preparing regional energy supply forecasts, in designating protected areas, and in ranking hydropower sites. Data obtained should also be of long-term value to a wide range of interests, including hydropower developers, environmental organizations, management authorities, and the public.

Evaluate Procedures by which Migrating Adult Salmon and Steelhead Are Counted and Accounted for, and Compile all Available Information on 'Losses' between Projects (84-42)

Unaccountable losses of returning adult salmon and steelhead occur between the hydroelectric facilities of the Columbia River. Such losses have been attributed to four major factors: problems at dams, bio/environmental causes, harvest-related causes, and tributary turnoff and mainstem spawning.

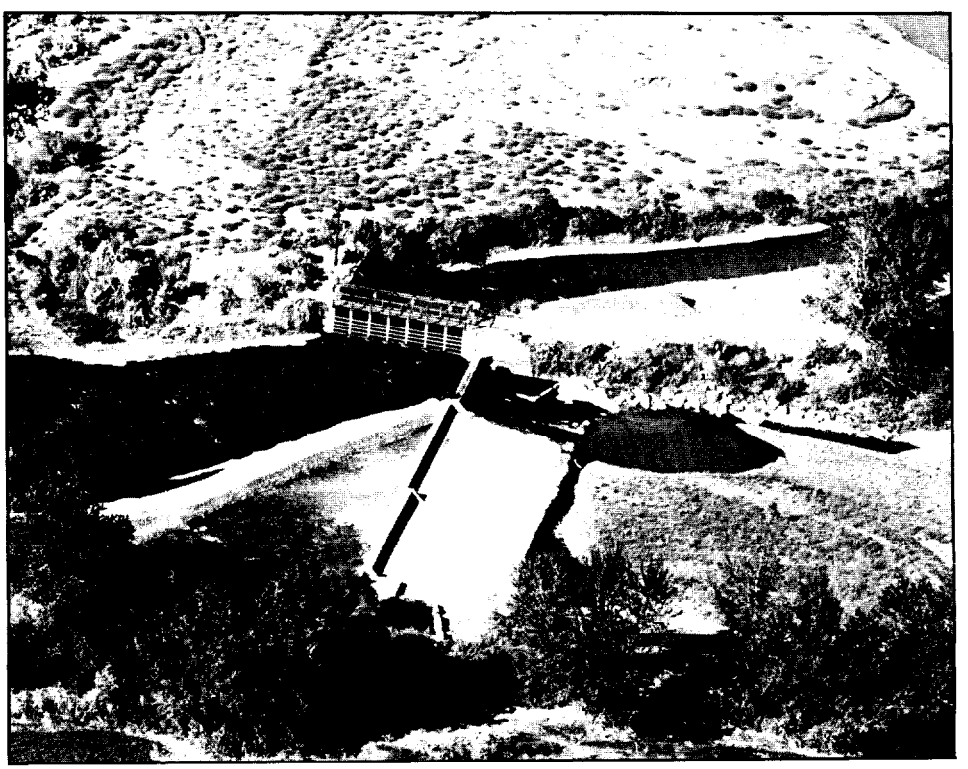
This study, conducted by the National Marine Fisheries Service, will evaluate all the procedures used to determine the numbers and distribution of migrating adults within the Columbia River system and compile all available data on fish losses between dams.

Researchers are collating all available fish counts at the Lower Columbia and Snake River dams. They are obtaining all available information on harvest. tributary turnoff, reservoir and dam mortality, and mainstem (reservoir) spawning. For both tasks, they note the accounting procedures used and estimate their accuracy.

The investigation's ultimate aim is to determine when and where significant losses (or discepancies in fish counts) have occurred, and why. Researchers will relate these losses to water flows, water temperatures, accounting procedures, and other possible contributory factors. The NMFS will eventually recommend new procedures or studies for species and locations that consistently show losses.

Dennis Maxwell

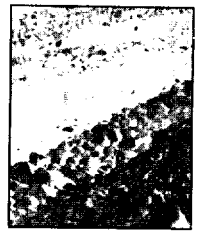
Improvirig habitat for wild salmon and steelhead runs mitigates for anadromous fish losses on the mainstem of the Columbia River.

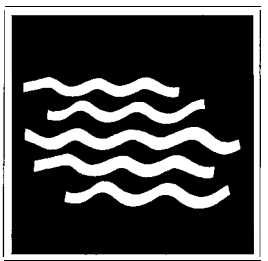


Dennis Maxwell

Westland Diversion Dam. During irrigation season, diversion darns displace over 95 percent of the Umatilla's flow.

YAKIMA BASIN





During this century, irrigation waters have transformed the dry but fertile Yakima Basin from a dusty prairie into one of the most productive agricultural regions in the world. But drawing water from the streams has taken a heavy toll on anadromous fish.

Irrigation and other water uses can dramatically reduce river flows and lower the quality of the water. Below the diversion dams installed throughout the basin, the river becomes no more than a series of standing pools in low water years and may dry up completely. Water temperature in the pools can reach 75 or 80 degrees, much too high for cold water fish. Irrigation waters returning to the river channel also bring sediment and agricultural chemicals which further degrade water quality.

In addition to low river flows and tainted water, the fish runs have also suffered from inadequate passage facilities at the diversion dams. Some were built without fishways, and at others they are poorly maintained or not working. However. most of the streams above the diversion structures would provide good spawning and rearing habitat for salmon and steelhead if they were accessible.

Fishery experts believe the Yakima Basin could support greatly increased populations of anadromous fish. To preserve and enhance the fish runs, BPA is cooperating in a program to renovate and modernize existing fish passage facilities and add new ones where needed. Though virtually all the damage to Yakima fish runs is due to irrigation and not hydropower, this series of projects, begun in 1984, is considered compensation for fish losses occuring at hydro facilities on the mainstem Columbia.

Many organizations and agencies are involved with BPA in the habitat improvement and passage enhancement projects, including the Northwest Power Planning Council, the Bureau of Reclamation, the Yakima Indian Nation, the Washington State Departments of Ecology, Fisheries, and Game, the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the Bureau of Indian Affairs, and Pacific Power and Light Co.

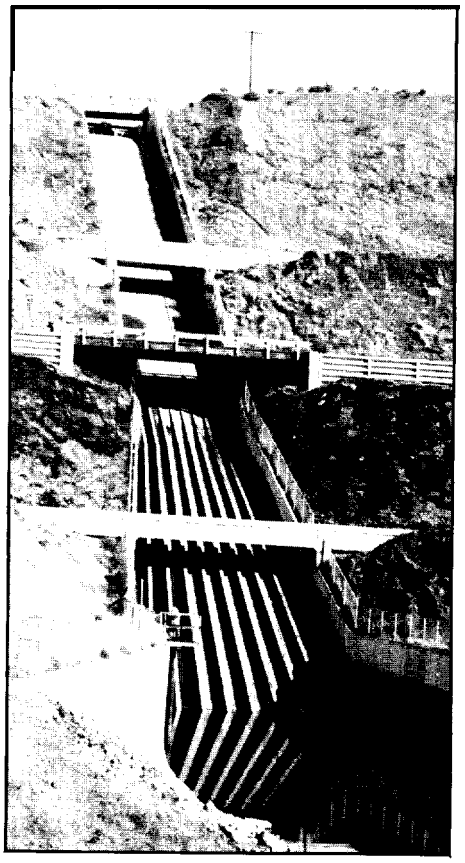
Yakima Basin Fish Passage Enhancement (84-48, 84-55, 84-56. 84-57, 84-58, 84-60, 84-61, 85-62, 85-85)

Fish passage facilities are being installed or renovated at 20 sites in the Yakima Basin. Construction was completed in 1985 on fish screens at Sunnyside Canal (84-55). operated by the Sunnyside Valley Irrigation District. and at the Richland Canal at Horn Rapids Dam (84-56, 84-60). The screens direct downstream migrants. diverted from the Yakima River by irrigation flows, back into the river channel. A project to evaluate the effectiveness of these fish screens (85-62) was completed at the end of 1985. Data indicates that 100 percent of the fish were passing the Sunnyside screen safely.

Construction also began on fish screens at the main canals of Wapato Diversion Dam (84-57) and the Satus Unit Diversion Dam on Toppenish Creek (83-58). In another project (85-85). Washington State University is making channel modifications at Toppenish Creek to provide interim passage for migratory fish into the creek headwater before permanent passage improvements are installed in about 2 years.

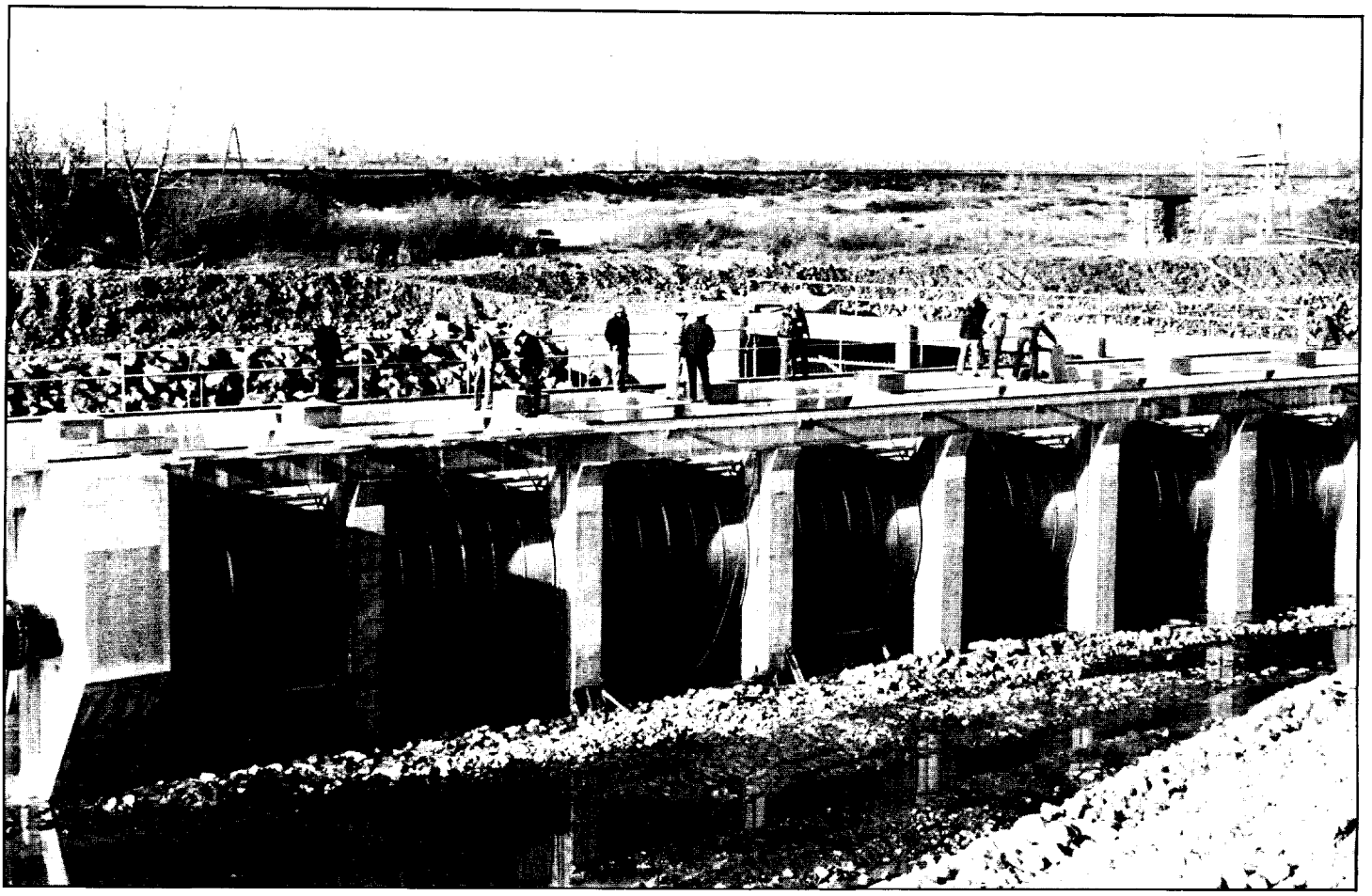
BPA is providing funds for fish passage facilities at Sunnyside Dam and for screens on the Old Reservation Canal on the Yakima Indian Reservation (84-61). Sunnyside Dam. which had one functioning but inadequate fish ladder. is having three new ladders installed. The first was finished in 1985. Old Reservation Canal. operated by the Bureau of Indian Affairs, previously had no screens, and young fish were easily trapped in the canal. The new screens are designed to correct this situation.

Under project 84-48. the U.S. Bureau of Reclamation completed the predesign phase of the remaining 10 Yakima Basin projects.



Sharon Blair

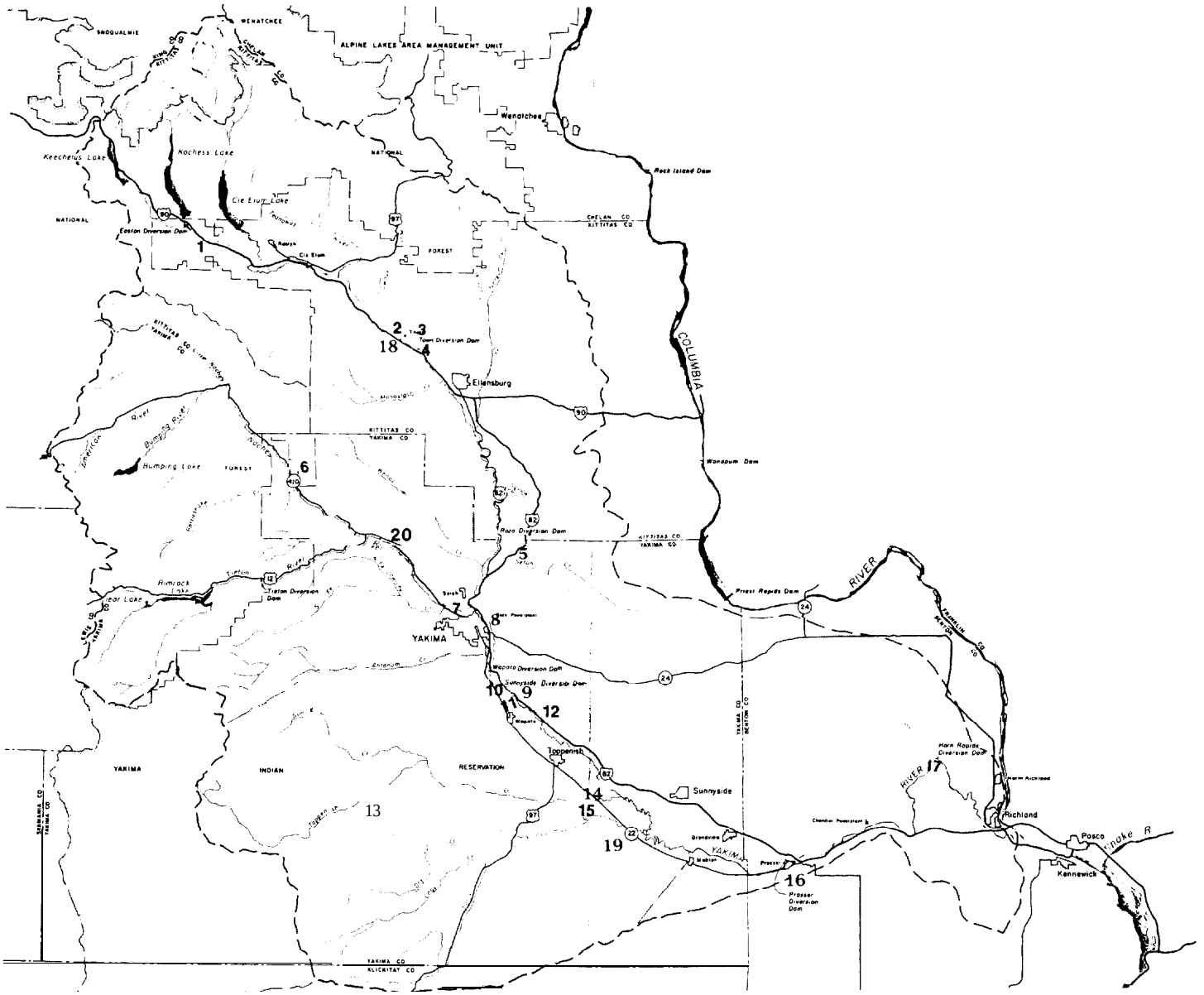
A new fish screen will keep young fish from entering the Roza Power Plant Wasteway



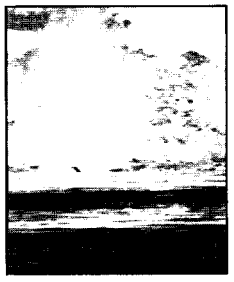
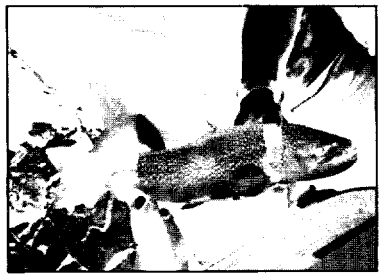
Sharon Blair

The new Sunnyside fish screens the first of 20 fish passage improvements for the Yakima.

YAKIMA RIVER BASIN



1. Easton Diversion Dam
2. Westside Canal Diversion
3. Thore Mill Diversion
4. Town Diversion Dam
5. Roza Diversion Dam
6. Stevens Ditch Diversion
7. Naches/Cowiche Diversion
8. Roza Powerplant Wasteway
9. Wapato Diversion Dam
10. Old Reservation Canal Diversion
11. Sunnyside Diversion Dam
12. Snipes/Allen Diversion
13. Toppenish Creek Diversion
14. Marion Drain Diversion
15. Toppenish Creek/Satus Unit Dive
16. Prosser Diversion Dam
17. Horn Rapids Diversion Dam
18. Taneum Diversion Dam
19. Satus Creek Diversion
20. Wapatox Diversion Dam


RESIDENT FISH


Unlike the salmon and trout species that migrate to and from the ocean, resident fish spend their lives in the fresh waters of the Columbia Basin. At least 20 species of game fish develop, mature, and reproduce in the basin. including kokanee (a race of landlocked sockeye salmon), Dolly Varden or bull trout, and westslope cutthroat trout.

The white sturgeon is one of the species of resident fish that is migratory. Columbia River sturgeon historically migrated upstream in fall and downstream in late winter or spring, until dams blocked their path. Since they do not use the fish ladders built for salmon, sturgeon are now restricted to stretches of the Columbia and Snake Rivers between the dams, where isolated populations inhabit the reservoir pools. Little is known about sturgeon life history and behavior, so BPA has funded two projects to gather information.

Hydroelectric facilities and their operations can affect all species of resident fish. When reservoir levels are high, nesting gravels are covered with silt which smothers incubating eggs. As water levels fall, nests are left exposed. Low water also disrupts spawning activity, as salmon and trout are kept from entering shallow tributaries.

Reservoir water levels sometimes fluctuate daily, eroding banks and destroying shallow vegetation that provides both food and shelter for young fry. Changing water levels may also affect production of the aquatic organisms, a major food supply for fish at all life stages. The littoral zone, the shallow edge, is usually the most productive part of a lake. In some reservoirs, that edge has become a barren mudflat.

Resident fish are of considerable economic importance, especially in areas no longer accessible to anadromous fish. BPA in 1985 funded 12 studies on resident fish populations, their food and habitat preferences, reproductive success, and their response to conditions in rivers above and below dams.

Resident Fish:
Program Descriptions

Effects of' Operation of Kerr and Hungry Horse Dams on Reproductive Sucess of Kokanee in the Flathead System (81-105)

Cumulative Inpact Study of Microhydro Sites, Swan River (82-19)

Lower Flathead Fisheries Study (83-l)

Columbia River White Sturgeon Life History and Genetics Study (83-316)

White Sturgeon Research Program Development (85-64)

Evaluation of Management for Water Releases for Painted Rock Reservoir Bitterrroot River, Montana (83-463)

Quantification of Hungry Horse Reservoir Levels Needed to Maintain or Enhance Reservoir Fisheries (83-465)

Quantification of Libby Reservoir Levels Needed to Maintain or Enhance Reservoir Fisheries (83-467)

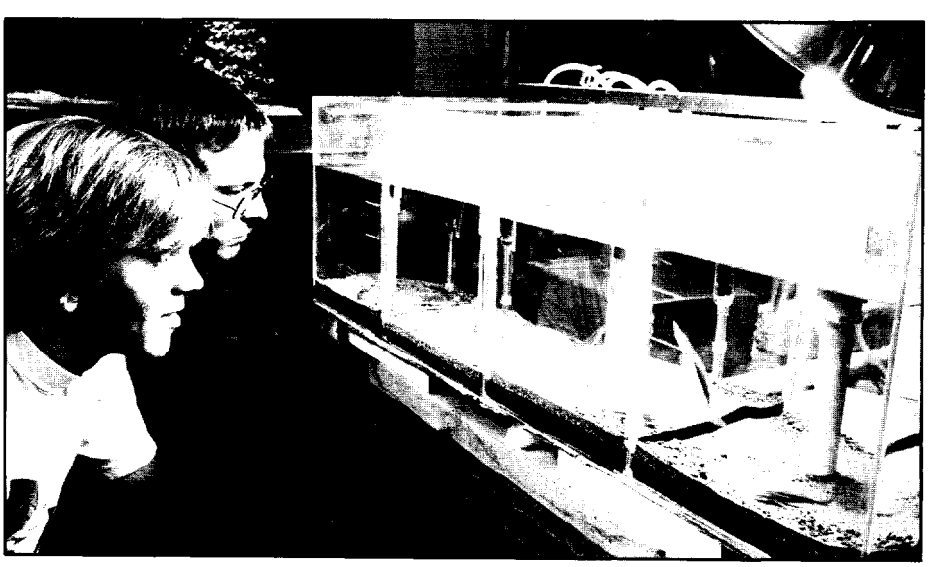
Cabinet Gorge Kokanee Hatchery (84-19)

Study of Instream Flows Needed to Mitigate Trout Impacts of Libby Dam (85-6)

Determination of Resident Fishery Losses in Tributaries of the South Fork Flathead River (85-23)

Colville Tribal Hatchery Pre-design (85-38)

Kokanee Stock Status and Contribution of Cabinet Gorge Hatchery, Lake Pend Oreille, Idaho (85-339)



Wes Taft

Scientists seek to unravel the mystery of sturgeon life history

Effects of Operation of Kerr and Hungry Horse Dams on Reproductive Success of Kokanee in the Flathead System (81-105)

Kokanee, a landlocked race of sockeye salmon, make up almost 90 percent of the total game fish harvest on Montana's Flathead Lake, but their numbers have been rapidly declining since the late 1970s. Biologists belicvc that reduced spawning by the lake shoreline and in the mainstem Flathead River is caused largely by the operation of Kerr and Hungry Horse Dams.

Montana Department of Fish and Wildlife is studying what flows from these dams will optimize spawning, incubation, and rearing conditions for kokanee in the upper Flathead River and lake with the least impact on power production.

Researchers are monitoring the timing and distribution of kokanee runs to learn what effects controlled flows have on their reproduction and survival in portions of the river above the lake. They will also examine how Kerr Dam discharges affect kokanee spawning and incubation in Flathead Lake. The study, begun in 1981, is scheduled for completion in 1987.

Cumulative Impact Study of Microhydro Sites, Swan River (82-19)

When the country seemed to be facing energy shortages in the late 1970s. Congress passed legislation providing incentives to encourage the development of renewable energy resources. including small-scale hydroelectric generation. As a result, by 1982, entrepreneurs had proposed over 100 small hydro projects in western Montana, including 22 for the Swan River drainage area.

This prompted BPA to initiate a study to learn how several microhydro projects in a single drainage could affect the fish population. Biologists from Montana Department of Fish. Wildlife, and Parks and the U.S. Forest Service in 1985 completed the assessment of possible cumulative effects. both biological and economic

By the end of the study. all the small hydro permits for the Swan River were withdrawn. However, the agencies developed a fisheries impact

U.S. Fish and Wildlife Service

Sturgeon once migated throughout the Columbia River Basin; now their movements are limited by hydroelectric dams

methodology that should prove useful in assessing microhydro impacts at similar sites. Biologists also gathered substantial data on fish life in the Swan drainage. As a result, they closed four bull trout spawning streams to fishing.

Lower Flathead Fisheries Study (83-l)

Researchers from the Confederated Salish and Kootenai Tribes of the Flathcad Reservation are checking the status of resident fish species in the Lower Flathead River and how they arc affected by the operation of Kerr and Hungry Horse Dams.

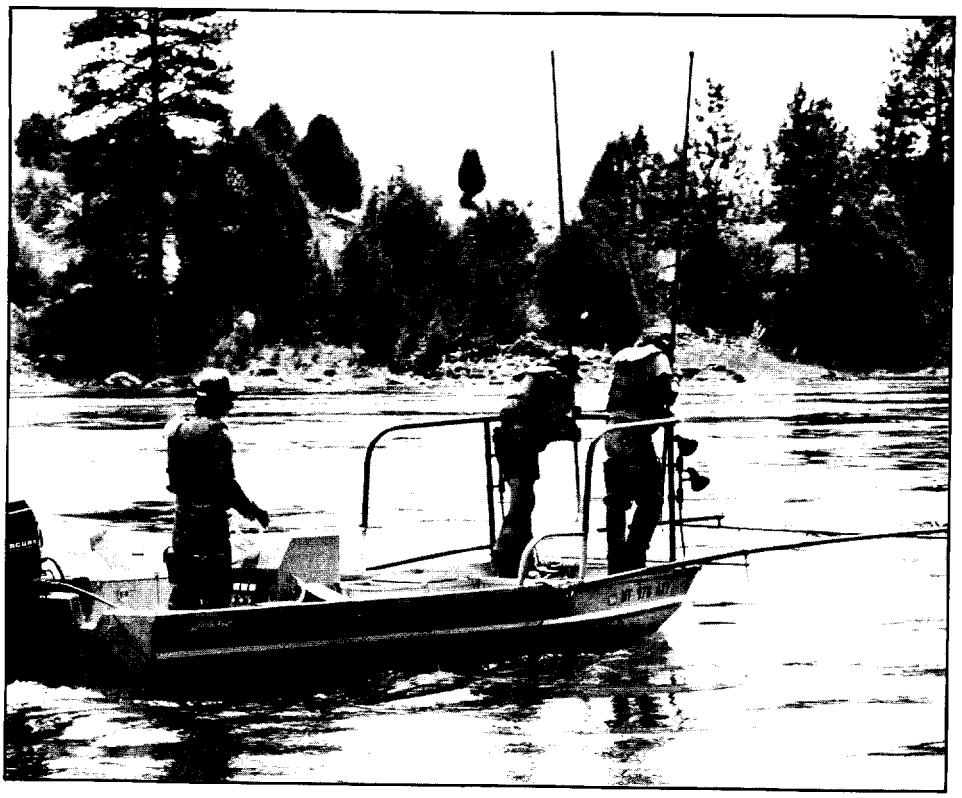
Trout, northern pike. and largemouth bass, and the interrelationships among these species, are the primary focus. The study is investigating possible alternatie ways to manage and protect the tribal fishery resource, including regulating sport and subsistence fishing and controlling the development and operation of new and existing hydro facilities.

The project team will also recommend ways to make up for past fish losses at the dams. One possibility being considered is to increase the amount of quality aquatic habitat to encourage game fish propagation. They arc also studying the potential effects of future hydroelectric development on these resident fish species. The project runs through 1987.

Columbia River White Sturgeon Life History and Genetics Study (83-316); White Sturgeon Research Program Development (85-64)

Once white sturgeon migrated throughout the Columbia River Basin. but now hydroelectric dams block their migratory routes. Biologists speculate that an altered environment has changed the sturgeon's behavioral pattern, but surprisingly little is yet known about this species' behavior or needs.

A University of Washington study (83-316) is gathering life history information that will help identify what environmental changes most affect the sturgeon. It is investigating the responses of young fish to changes in water temperature, flow, and other variables. The study is also identifying genetic distinctions among populations and whether stock supplementation is feasible. The results of the study will be used in designing programs to offset sturgeon losses.



Confederated Salish and Kootenai Tribes

Electroshocking stuns fish long enough for biologists to identify, tag and measure them

Battelle Pacific Northwest Laboratory. with input from the fisheries agencies, tribes, universities. and the private sector, is developing a comprehensive research plan for white sturgeon in the Columbia Basin (85-64). The project will identify all completed and ongoing research projects, coordinate research planning efforts in the region, and establish an information clearinghouse on the white sturgeon.

Evaluation of Management for Water Releases for Painted Rock Reservoir, Bitterroot River, Montana (83-463)

Montana Department of Fish. Wildlife. and Parks is working on a plan to aid the movements of fish spawning on the Bitterroot River, a tributary of the Clark's Fork of the Columbia River in Western Montana. Researchers are studying the feasibility of scheduling water releases at Painted Rock Reservoir to increase trout populations. at present limited by low water levels in the summer.

The agency is monitoring many aspects of the Bitterroot River, including water temperature, stream discharge, and water quality. The project team is also analyzing the area's salmonid fish habitat and monitoring brown and rainbow trout spawning activities to better define trout population and habitat requirements.

Quantification of Hungry Horse Reservoir Levels Needed to Maintain or Enhance Reservoir Fisheries (83-465); Quantification of Libby Reservoir Levels Needed to Maintain or Enhance Reservoir Fisheries (83-467)

Biologists from Montana Department of Fish. Wildlife. and Parks are studying the effects on resident game fish of water releases for power generation, flood control, or other water management activities. They are collecting data on the distribution of fish, their use of various reservoir zones, and the timing of each zone's physical parameters as they relate to important life stages of the fish.

The data will enable scientists to predict the effects of hydro operations on resident fisheries and recommend seasonal drawdown levels that are compatible with the needs of the fish. The two studies should be completed by 1988.

Cabinet Gorge Kokanee Hatchery (84-19)

Construction and operation of the Albeni Falls and Cabinet Gorge hydro projects has affected the kokanee population in Lake Pend Oreille in northern Idaho. This project involves building a fish hatchery on the Clark Fork River to compensate for the problems caused by the facilities.

Funding comes through a three party cooperative agreement: BPA and Washington Water Power each provide half the cost of design and construction. while Idaho Department of Fish and Game funds the operation and maintenance. Work began in 1985 and will be completed by early 1986.

Study of Instream Flows Needed to Mitigate Trout Impacts of Libby Dam (85-6)

The Kootenai River supports one of Western Montana's most popular trout fisheries. A dense population of wild rainbow trout, most of them resident fluvial fish bred from native and hatchery stocks, inhabits the SO miles of river from Libby Dam to the Idaho border. Migratory fish also reside in the Kootenai River but mostly spawn in tributary streams. Lake Koocanusa, the reservoir behind Libby Dam, also supports populations of rainbow and cutthroat trout and kokanee salmon, which all use the tributaries for spawning and/or rearing.

In this study, Montana Department of Fish, Wildlife and Parks is determining what level of instream flows are required to ensure successful migration, spawning and rearing of salmonids in five tributaries of the Kootenai River and six tributaries of Lake Koocanusa. Several of these sites are targeted for micro-hydro development, and irrigation diversions exist on at least two streams.

Determination of Fishery Losses in the South Fork of the Flathead River and Tributaries Resulting from Flooding by Hungry Horse Reservoir and the Proposed Mitigation Alternatives (85-23)

Construction of Hungry Horse Dam in 1951 flooded some 35 miles of the South Fork Flathead River and portions of about 50 tributary streams. eliminating large areas of trout spawning and rearing habitat. The dam also blocked access to about 40 percent of the drainage area available for spawning salmonids migrating upstream from Flathead Lake, isolating migratory species such as the westslope cutthroat, bull trout, and mountain whitefish. Montana DFWP began this study in 1985 to estimate fishery losses as a result of Hungry Horse Dam and propose ways to rehabilitate the fishery.

Colville Tribal Hatchery Pre-design (85-38)

In 1984, the Northwest Power Planning Council agreed that the Colville Indians should receive funding for the design. construction. operation. and maintenance of a resident trout hatchery on their reservation. BPA initiated hatchery work group meetings with representatives from the Colville Confederated Tribes and Federal, state, and local agencies to coordinate planning, design, and construction of the facility.

The Colville Tribe is conducting the pre-design study for the hatchery project. The study team will develop a detailed hatchery plan, including preliminary layouts and drawings, cost estimates, selected alternatives, conclusions, and recommendations. The final report is due in 1986.

Kokanee Stock Status and Contribution of Cabinet Gorge Hatchery, Lake Pend Oreille, Idaho (85-339)

Idaho Department of Fish and Game is conducting this study to evaluate what contribution the new Cabinet Gorge Hatchery will make to the kokanee salmon fishery in Lake Pend Oreille. The Northwest Power Planning Council called for construction of the hatchery on the Clark Fork River in its Fish and Wildlife Program, BPA, Washington Water Power Company, and IDFG collaborated in the construction, which was completed in November 1985, a year ahead of schedule.

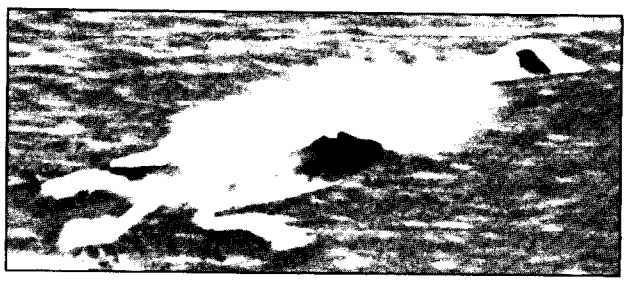
During 1985, researchers were assessing the status of kokanee in the lake before hatchery releases begin in 1986. They estimated population size, age composition, and the proportion of wild to hatchery-reared fish, and also compared growth and survival rates to population density and the carrying capacity of Lake Pend Oreille. The team also collected harvest data for comparison with data after the hatchcry starts kokanee production. Work will continue through 1989.

U.S. Fish and Wildlife Service

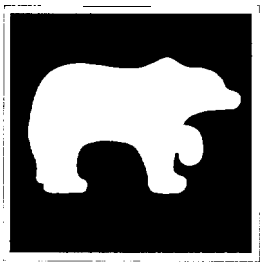
Kokanee spawners in McDonald Creek, Glacier National Park

Ron Smith

A tribal biologists weighs and measures a brown trout from the Lower Flathead River.



WILDLIFE



The impact of Pacific Northwest hydroelectric development reached beyond the rivers and streams into the surrounding hillsides. Wildlife are also experiencing the effects of a diminished or altered natural habitat.

Reservoirs now cover what used to be critical floodplain and riparian habitat for several species. Waterfowl have lost island nesting sites along the Pacific flyway. Frequent fluctuations in reservoir water levels have left streamside areas bare, exposing animals and wildfowl as they find their way to the water's edge. Changes in wetland and riparian vegetation have been severe enough to alter the composition of wildlife species and in some cases render wildlife more vulnerable to predators.

Biologists report that the availability of wintering range is an important factor limiting big game populations. Much wintering range was lost when rivers suddenly became lakes. But it is the quality, not just the quantity, of rangeland that ensures certain species thrive.

Many animals spend their summers on high mountain slopes within the national parks and the wilderness areas of national forests. In winter, deep snows cover their luxuriant pastures and force them down to the valleys. There, they may have to compete with with domestic livestock for overgrazed vegetation low in essential nutrients.

The malnourished animals often feel the effects of winter long after the snows have melted, especially females who give birth in the spring. Lack of a high-protein diet for lactating females is directly tied to offspring mortality.

In 1985, BPA funded the following studies to address wildlife concerns.

Wildlife:
Project Descriptions

Impact of Water Levels on Canada Geese (83-2)

Evaluation of the Effects on Wildlife and Wildlife Habitat Associated with Development of Hydroelectric Projects in Montana (83-464)

Impacts of Water Levels on Productivity of Canada Geese in the Northern Fluthead Valley (83-498)

Willamette River Projects Wildlife Mitigation and Enhancement Planning (84-36)

Ural-Tweed Bighorn Sheep Wildlife Mitigation Projects (84-38, 84-39)

Wildlife and Wildlife Habitat Loss Assessments for the Anderson Ranch, Black Canyon, and Boise Diversion Hydroelectric Facilities in Idaho (85-l)

U.S. Fish and Wildlife Service

Reservoir fluctuations can either flood goose nests or leave goslings exposed to predalors.

Impact of Water Levels on Canada Geese (83-2); Evaluation of the Effects on Wildlife and Wildlife Habitat Associated with Development of Hydroelectric Projects in Montana (83-464); Impacts of Water Levels on Productivity of Canada Geese in the Northern Flathead Valley (83-498)

The Flathead Valley is one of the major breeding areas in North America for Canada geese. hut operation of nearby hydroelectric facilities, with the resultant fluctuation in water levels, may be exposing these wildfowl to hazards.

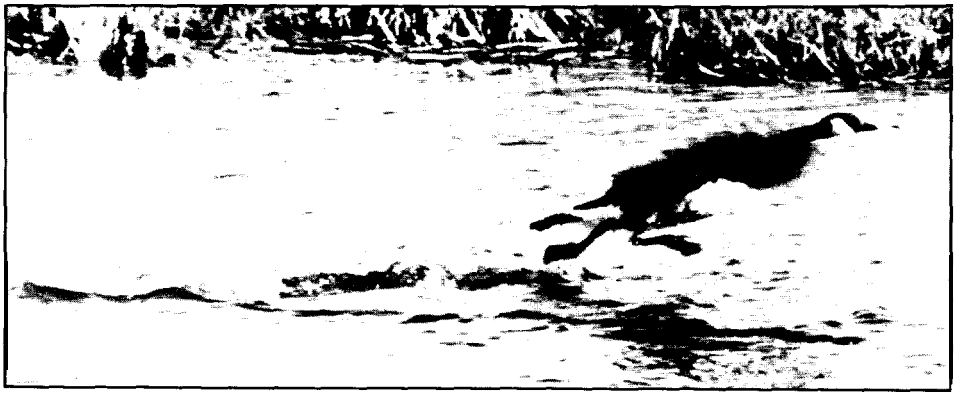
Biologists working for the Salish-Kootenai Tribes are studying Canada geese on the south half of Flathead Lake and the upper Flathcad Rivet (83-2). In 1985, they continued evaluating how the operation of Kerr and Hungry Horse dams affect nesting habitat. nesting success. and gosling survival. By 1987, they will analyze the data and recommend ways to protect the wild geese.

Montana Department of Fish, Wildlife, and Parks is conducting two related studies. In project 83-464, they are evaluating the effects of Hungry Horse Libby, and three Clark Fork dams on wildlife and wildlife habitat. They have estimated net losses of wildlife species, habitat types, and habitat acreage, and have developed plans for mitigating these losses.

On the north shore of the lake and on the upper Flathead River, MDFWP is inventorying Canada goose nesting and brooding habitats and evaluating nesting success and gosling survival. The study will help biologists determine how best to manage the goose population under given water level constraints. Data collection was completed in 1985, and recommendation should be ready in 1986.

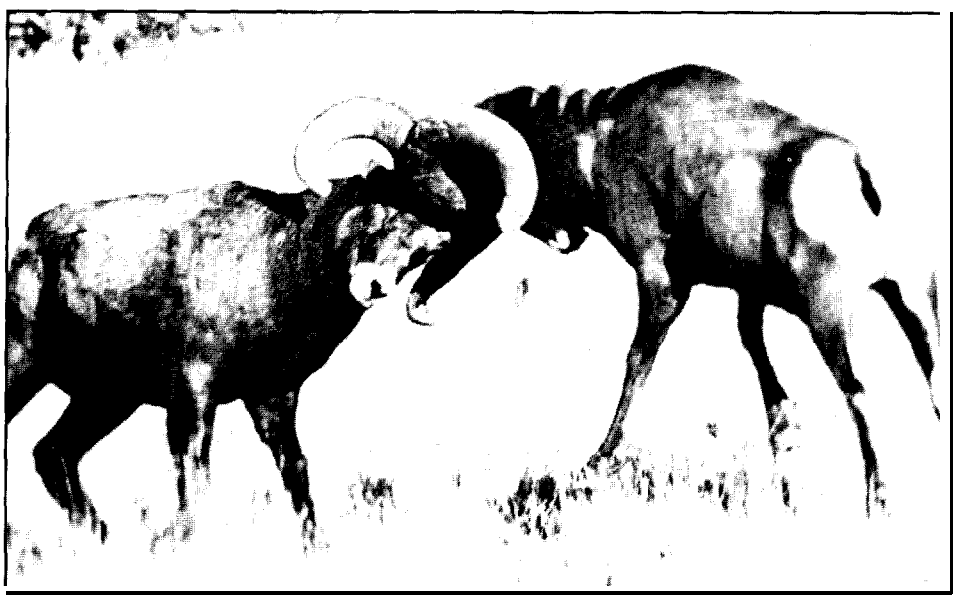
Willamette River Projects Wildlife Mitigation and Enhancement Planning (84-36)

Inundation and water level fluctuations at the Federal Willamettc River hydroelectric facilities in Oregon have also affected wildlife and its habitat. Researchers have assessed how the construction and operation of the hydro facilities have impacted wildlife and have estimated Iosscs to populations and habitat. During 1986, they will complete their outline of wildlife habitat mitigation and enhancement opportunities on the Willamette. Actual projects to help affected species recover from losses will be identified later.



U.S. Fish and Wildlife Service

Biologists are working to protect the wild Canada goose m Western Montana's Flathead Valley.



U.S. Fish and Wildlife Service

By improving habitat biologists hope to increases the number of Ural-Tweed bighorn sheep.

Ural-Tweed Bighorn Sheep Wildlife Mitigation Projects (84-38. 84-39)

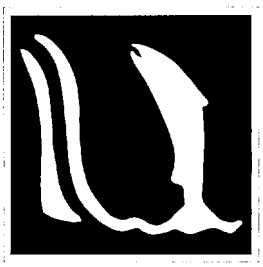
A small herd of Ural-Tweeds - the last remnant of western Montana's native population of bighorn sheep - is on the edge of extinction after declining drastically for the past 20 years. Vital areas of spring and winter range have been lost to development projects. such as the impoundment of the Kootenai River by Libby Dam. The filling of the Lake Koocanusa reservoir inundated sonic 4,350 acres of rangeland.

The U.S. Forest Service's Kootenai National Forest, through project 84-38, is improving existing habitat conditions by seeding new grass stands and treating grass and shrub areas in poor condition. MDFWP, in project 84-39, monitors herd responses to the improved vegetation, which eventually will cover some 1,500 acres of critical spring and winter range. The herd now numbers 40-up from 25 a few years ago. These 5-year projects should conclude in 1988.

Wildlife and Wildlife Habitat Loss Assessments for the Anderson Ranch, Black Canyon, and Boise Diversion Hydroelectric Facilities in Idaho (85-1)

Idaho Department of Fish and Game is estimating losses to wildlife and wildlife habitat resulting from the construction and operation of the Anderson Ranch, Black Canyon, and Boise Diversion hydro projects. Data collected will help establish efforts to protect and enhance wildlife in the area to make up for the adverse impacts of the hydro development.

PROGRAMWIDE ACTIVITIES



BPA funded one new project and two existing projects in 1985 which address the "big picture". The objective of these programwide studies is to evaluate and quantify the overall effects of hydroelectric development on fish and wildlife and to create standards and accounting policies for the projects undertaken to offset negative impacts.

Such studies enable BPA to efficiently integrate important fish and wildlife concerns into agency plans and programs. The information also helps BPA develop policies that fulfill its responsibilities under the Pacific Northwest Power Act to afford fish and wildlife "equitable treatment" with power generation in the management and operation of the region's Federal dams.

Development of Criteria and Methods for Assessing Potential Cumulative Effects of Hydroelectric Development on Fish and Wildlife (84-41)

A single hydroelectric development can cause measurable losses to fish and wildlife in and around it. but when several developments are concentrated in one river basin the cumulative impact may be far greater than what would be expected from the given number of dams.

Past planning did not sufficiently consider the impact of individual projects in relation to the effects of other existing and proposed projects. Consequently, hydroelectric development in some basins has resulted in unusually large losses to fish and wildlife.

The purpose of this study, begun in 1984, is to develop two methodologies to assess these cumulative effects. Researchers examined the literature and analyzed existing techniques for assessing the effects of hydroelectric development.

Determination of the Extent of the Administrator's Obligation to Protect, Mitigate, and Enhance Fish and Wildlife (84-49)

This l-year study was to develop an overview of economic and related research issues inherent in any determination of limits to BPA's responsibility to protect, mitigate, and enhance fish and wildlife.

The report provided a foundation for BPA to formulate a major public policy to estimate fish and wildlife losses due to development and operation of the Federal Columbia River Power System as the basis from which to determine when the agency's responsibilities would be fulfilled. The procedure will also guide BPA evaluations of mitigation proposals on a systematic and uniform basis and guide measuring and accounting for progress attributable to BPA-sponsored efforts.

During 1985, the research problems were defined as a basis for development of the following project (85-87).

Design of Studies for Development of BPA Fish and Wildlife Mitigation Accounting Policy (85-87).

This 28-month study. initiated in 1985, will design studies to be used in developing methods to estimate salmon and steelhead losses from hydro development in the region. These methods will also be used to evaluate alternative mitigation proposals and to measure progress attributable to BPA-sponsored mitigation efforts. The research will help develop BPA Fish and Wildlife Mitigation Accounting Policy. whereby BPA responsibility to protect, mitigate, and enhance fish would be determined from an empirical and analytical basis and would be fulfilled with maximum net benefit to the region.

Researchers are attempting to formulate an analytical system of the ecologic. hydrologic. and economic aspects of anadromous fish production in the Columbia Basin. The challenge is to find ways to simulate the impact of the existing hydroelectric system on fish productivity and to provide an analytical foundation for projecting the fish productivity response to proposed changes in the biologic and hydrologic system. The analytical system should, after biologic and hydrologic data are integrated. provide an estimate of total losses and of the proportion of fish losses attributable to FCRPS functions.

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